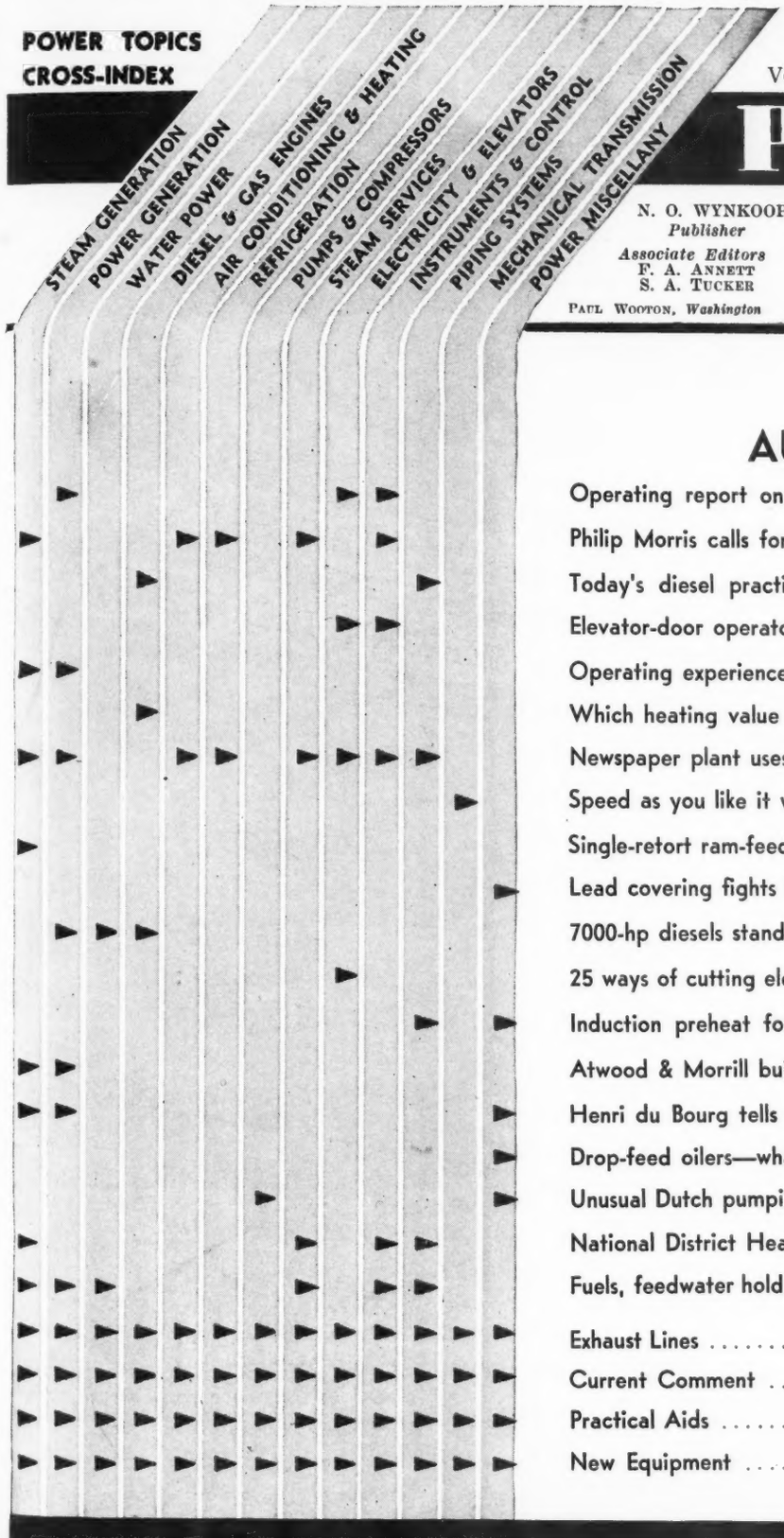



VOLUME 82 NUMBER 8

# POWER

N. O. WYNKOOP, *Publisher*
PHILIP W. SWAIN, *Editor*

*Associate Editors*
F. A. ANNETT
S. A. TUCKER

E. J. TANGERMAN, *Consulting Editor*

*Assistant Editors*
B. E. SAWYER
L. N. ROWLEY

PAUL WOOTON, *Washington* G. C. TENNEY, *San Francisco* H. S. KNOWLTON, *Boston*

## AUGUST, 1938

Operating report on four hydrogen-cooled generators.... 38
Philip Morris calls for modern steam and power services... 42
Today's diesel practice—oil-purification systems..... 44
Elevator-door operatots modernized with dynamic braking.. 47
Operating experiences at Keystone Public Service Co..... 48
Which heating value should be used for gaseous fuels?.... 49
Newspaper plant uses exhaust steam for conditioning..... 50
Speed as you like it with variable-speed transmissions..... 52
Single-retort ram-feed stokers—second of a series..... 54
Lead covering fights lighting-rod-system corrosion..... 57
7000-hp diesels standby for Arizona hydro system..... 58
25 ways of cutting electric power costs in your plant..... 60
Induction preheat for carbon-molybdenum-pipe welding... 62
Atwood & Morrill builds common-sense 75-kw steam plant.. 63
Henri du Bourg tells of pulverized coal's early days..... 64
Drop-feed oilers—what they are and how they work. ..... 67
Unusual Dutch pumping plant completes 84-year stint..... 69
National District Heating Assn. meets in Baltimore, Md.... 73
Fuels, feedwater hold attention of mechanical engineers.... 74

DEPARTMENTS

Exhaust Lines ..... 66
Current Comment ..... 77
Practical Aids ..... 82
New Equipment ..... 92
Data Sheet No. 72..... 72
Power Lines ..... 78
Readers' Problems ..... 88
George Edwards ..... 100

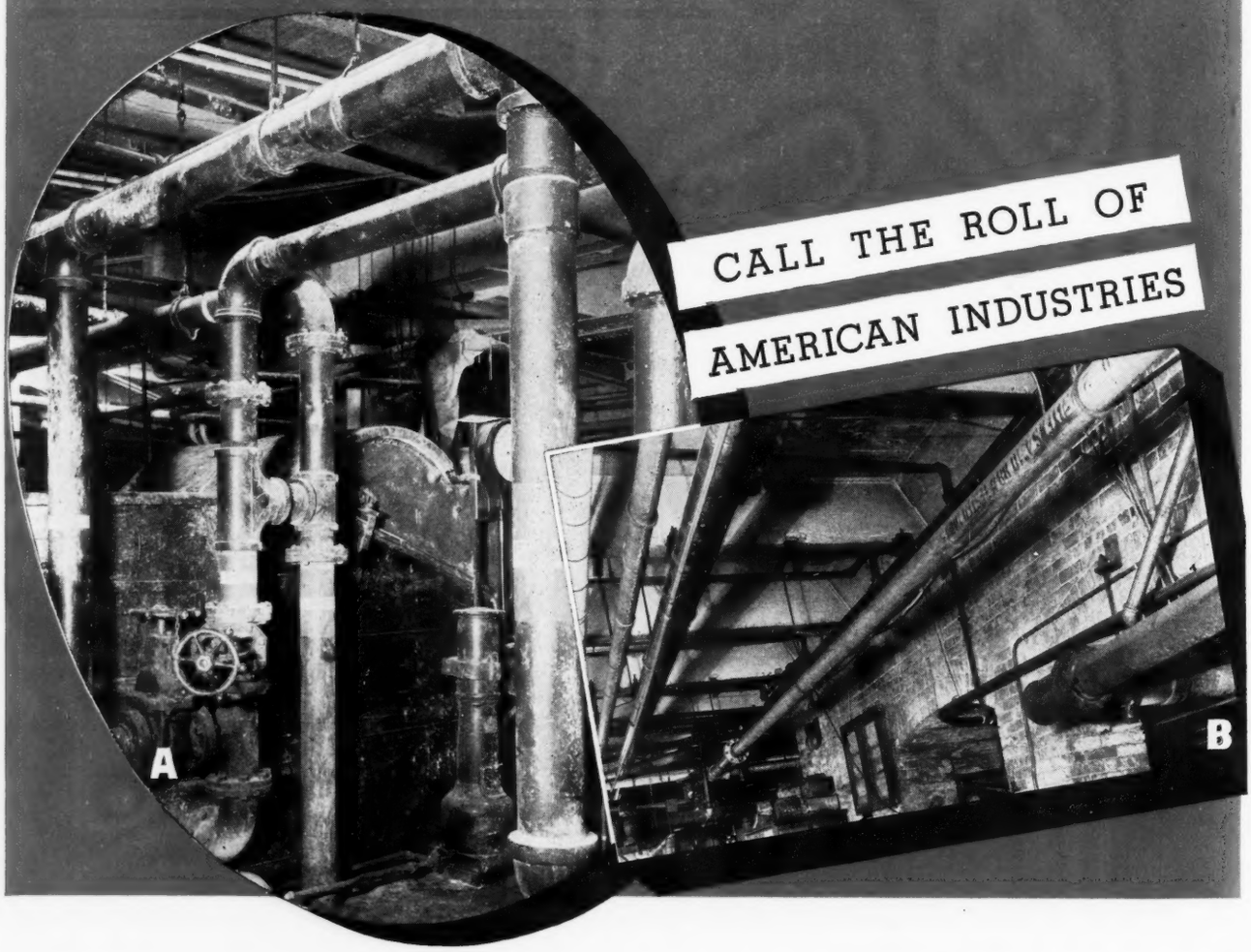
JAMES H. MCGRAW, JR., President
HOWARD EHRLICH, Executive Vice-President
MASON BRITTON, Vice-Chairman
B. R. PUTNAM, Treasurer
D. C. MCGRAW, Secretary
A. W. MORRISON, Circulation Mgr.

CHICAGO, 520 North Michigan Ave.
SAN FRANCISCO, 883 Mission St.
WASHINGTON, National Press Bdlg.
PHILADELPHIA, 16 South Broad St.
CLEVELAND, 1510 Hanna Bldg.
DETROIT, 2-257 General Motors Bldg.
ST. LOUIS, 455 Paul Brown Bldg.
BOSTON, 1427 Statler Bldg.
ATLANTA, 1105 Rhodes Haverty Bldg.
LONDON, Aldwych House, Aldwych, London, W C.2

Copyright, 1938, by McGraw-Hill Publishing Company, Inc.

POWER articles are currently indexed in both the Industrial Arts and the Engineering Indexes, available at public libraries. Also every year POWER issues an annual index of its own. Cable Address: "McGraw-Hill, N. Y."

# WROUGHT IRON
## CURBS CORROSION FOR
## Tileston and Hollingsworth Company, Paper Manufacturers




● Paper making involves highly corrosive processes. That is why paper mills use Byers Wrought Iron so extensively. Engineers in these plants have learned from long experience that wrought iron is able to resist the corrosion of process liquids that cause premature failure of ordinary metals.

At the Hyde Park, Mass., plant of Tileston and Hollingsworth Company, wrought iron has been used for many years. Some of the services are illustrated above: (A) wrought iron lines carrying "white water" to and from pulp-beating machines and (B) wrought iron lines for cold water, steam, sprinklers and condensates.

If you select piping for any industrial use in which corrosion or vibration is a factor, we suggest that you investigate the longer service life obtained under these conditions by using wrought iron. For factual evidence of this, write for our new illustrated bulletin, "Wrought Iron for Piping Systems."

If replacements must be made too frequently in some of your plant services, let us help you analyze the cause. Get in touch with our nearest Division Office or write our Engineering Service Department in Pittsburgh. A. M. Byers Company, Pittsburgh, Pa. Established 1864. Boston, New York, Philadelphia, Washington, Chicago, St. Louis, Houston, Seattle, San Francisco.

**BYERS GENUINE WROUGHT IRON**
TUBULAR AND FLAT ROLLED PRODUCTS
SPECIFY BYERS GENUINE WROUGHT IRON PIPE FOR CORROSIVE SERVICES AND BYERS STEEL PIPE FOR YOUR OTHER REQUIREMENTS

POWER

Established 1882 PHILIP W SWAIN, Editor

# *Winter of Work*

A FEW WEEKS AGO a certain practical-minded economist, in whom we place well-earned confidence, addressed our editors. He reviewed the general business nose-dive that started last year, and then spoke of things to come. This man is not a professional optimist. Early in 1937, when most business men were flushed with confidence, he clearly predicted this depression and was proved right by events, as he has generally been through many years of shrewd observation and analysis. Now he asserts, with equal emphasis, that every sign points to an early turn upward, possibly by Sept 1, certainly by winter.

It took the preceding depression three years to reach its low point in 1932. This time, our adviser reminds us, the downswing has been far swifter and so must be the rebound. On the basis of all previous experience he predicts an early and speedy recovery.

The editors of *Power* do not claim to be economic experts. In bringing this prediction to our readers we act merely as reporters. We also realize that economics is not an exact science and that no one can be absolutely certain of the business future. Yet we feel that the source of this forecast commands respect on the basis of past performance. We urge its tentative acceptance.

To function at all, business men and engineers must make some assumption regarding the months immediately ahead. Here is something far better than mere guess or hunch. *Power* readers should start watching for signs of a substantial business improvement within the next month or two.

So much for the general picture. The next question is this: If business swings upward, as we anticipate, what effect will it have on the power field and power men? Utility loads will rise sharply. So will the steam and electrical loads of industry. The sales of all types of power equipment will mount rapidly. In particular, heavy power equipment, which fell further, may be expected to rise further and faster than the average, even to the point of an ultimate traffic jam of orders and resulting slow deliveries. Finally, recovery will bring a substantial rise in prices.

Faced by these possibilities, every power executive must ask himself now whether returning prosperity will call for new equipment in his own plant to keep costs down or even to keep the plant running at the required capacity. If so, he must next consider how far he can afford to postpone ordering in a rising market with the ultimate possibility of delayed deliveries.

It is a common business failing to wait until a situation is overripe before taking action—to buy practically at the top of a boom and sell out at ebb tide. If, as we believe, the turn is almost here, the next few months will be a period of great financial opportunity for those responsible for plant construction and operation. As always, some will note the signs in time and take appropriate action. For them the winter of work now facing us will also be a winter of profit.

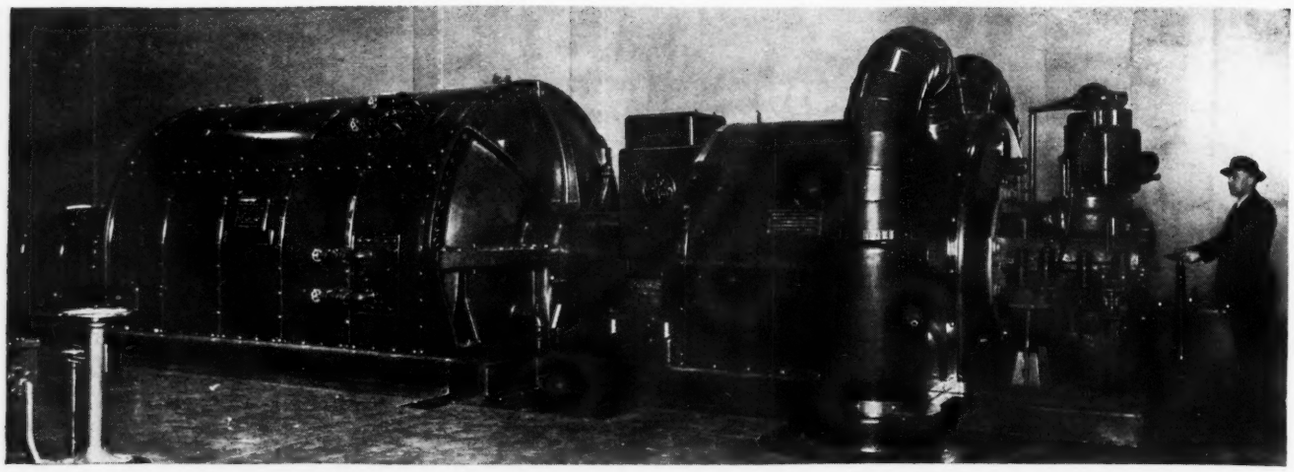


Fig. 1—25,000-kw, 0.8-pf, 3600-rpm, hydrogen-cooled generator at Dayton, Ohio

# Hydrogen-Cooled Generators

## First general report on operation of the four units now in service. Results have fulfilled expectations

By E H FREIBURGHOUSE and D S SNELL
*General Electric Co*

WITHIN the past 2½ years orders have been placed for 28 hydrogen-cooled generators, with a total capacity of over 1¼ million kw. Four are now in service. Sizes built or under construction range from 25,000 kw to 60,000 kw at 3600 rpm, and from 65,000 kw to 150,000 kw at 1800 rpm.

The first generator to go into commercial service with hydrogen cooling was the 25,000-kw unit of the Dayton Power & Light Co, Fig. 1, which began operating in hydrogen during October, 1937. This was followed in November by the 150,000-kw generator of the Chicago District Generating Corporation at Hammond, Ind., and in early December by the 40,000-kw unit of the Appalachian Power Co at Logan, W. Va. The 150,000-kw machine, originally built for air cooling, was designed for adaptation to hydrogen cooling, and was recently rebuilt as a hydrogen-cooled machine. The fourth is the 53,000-kw generator of the Consolidated Edison Co of New York, which began operating in hydrogen during July of this year. All four machines are of General Electric manufacture.

Hydrogen cooling for electric rotating machinery was first suggested in this country by Dr W R Whitney of the General Electric Research Laboratory in 1921. Laboratory tests on actual machines operating in hydrogen and other gases showed hydrogen superior to all other known gases. The turbine generator was early recognized as a particularly desirable application for hydrogen cooling, due to its high windage losses and adverse cooling factors. The chief problem is sealing rotating shaft extensions and much time and money were expended before a suitable shaft-seal was developed. In 1926 a 6250-kva, 3600-rpm generator, Fig. 2, designed for hydrogen cooling, was built and tested. One year's operation as a synchronous condenser demonstrated the reliability of shaft-sealing and hydrogen-control equipment and provided data upon which to base the design of larger machines.

Manufacturers were submitting quotations on hydrogen-cooled turbine-generators as early as 1927. The hydrogen-cooled synchronous condenser was introduced in 1928, followed by the hydrogen-cooled frequency converter. With these machines the problem of sealing the rotor shaft is not present; the entire unit can be completely enclosed in a gas-tight housing. There are now in service 19 of these two types with a total capacity of over ½ million kva, and their performance has been highly satisfactory.*

Present acceptance of hydrogen-cooled turbine-generators by the power industry has been brought about chiefly through the demand for increasingly larger units at 3600 rpm. Although improvements in materials and ventilation methods have been important factors, hydrogen cooling, offering approximately 20% more output from a given amount of material, has had a dominant part in this development.

### Advantages of Hydrogen Cooling

Advantages of hydrogen cooling are:

1. Due to lower density of hydrogen, windage losses of a machine operating in hydrogen (at 97% purity) are $\frac{1}{10}$ of their value in air.

2. As a result of the superior cooling properties of hydrogen, about 20% greater output can be obtained with the same amount of active material, for the same temperature rise of the windings. (Hydrogen has a thermal conductivity 7 times that of air, which greatly reduces the thermal resistance of all heat-flow paths that include gas spaces, such as the insulation and laminations. Also, the rate of surface heat transfer in hydrogen is about 35% greater than in air, which permits increased surface intensity of loss for the same surface temperature rise.)

* See "Operating Experience with Hydrogen Cooling," by R M Easely, *Power*, June, 1936.



See "Power" July 1936 ↑
Page 362
W.F.

3. The effect of corona on insulation is negligible in hydrogen, and the insulation retains its flexibility longer.

4. As hydrogen will not support combustion, fire hazard is eliminated.

Since the windage losses may represent from 40 to 50 per cent of the full-load losses, in an air-cooled turbine generator, the use of hydrogen cooling results in a considerable gain in efficiency. Fig. 3 shows this gain, at full load, to be about 0.65% for 1800-rpm machines, and about 0.85% for 3600-rpm machines. At partial loads, the improvement is considerably greater.

The size of gas coolers of hydrogen-cooled machines is only a fraction of that of air coolers. Losses to be removed are much less and rate of heat transfer to the cooler tubes is much greater.

The hydrogen-cooled machine is quieter than the air-cooled machine due to the virtual elimination of windage losses. The casing must be gas-tight and dirt and moisture effectively excluded, resulting in reduced maintenance.

## Explosive Mixtures Avoided

The chief disadvantage usually associated with the idea of hydrogen cooling is the possibility of an explosion. However, if the amount of hydrogen by volume in a hydrogen-air mixture is kept above 75% or below 5%, the mixture cannot be ignited. The purity of the hydrogen mixture is automatically maintained at approximately 97%, well above the upper limit of inflammability. A purity indicator, operating on the thermal-conductivity principle, shows hydrogen purity at all times. If the purity should fall below a designated value, usually 90%, a contact on the indicator operates an alarm. A fan pressure gage, calibrated to read hydrogen purity, gives confirmatory readings of hydrogen purity in the machine when in operation.

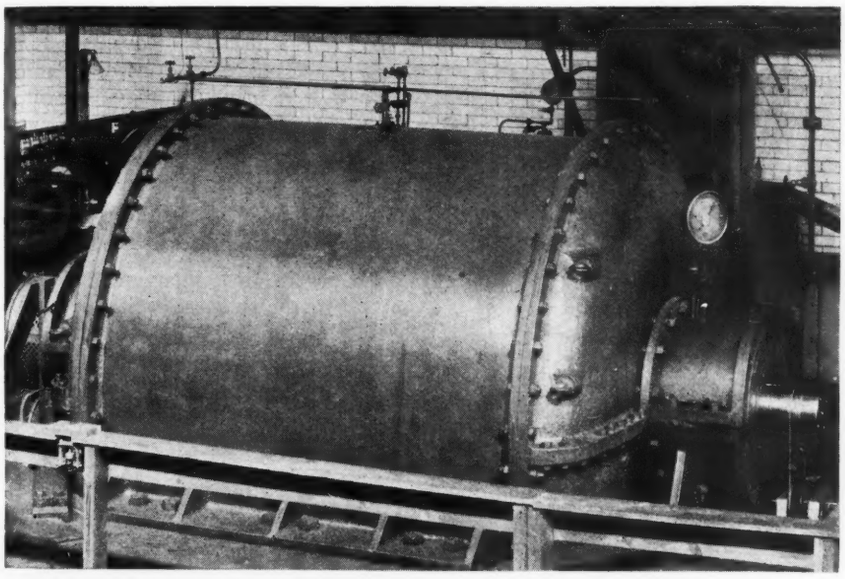


**Fig. 2—6250-kva 3600-rpm hydrogen-cooled generator under test as synchronous condenser**

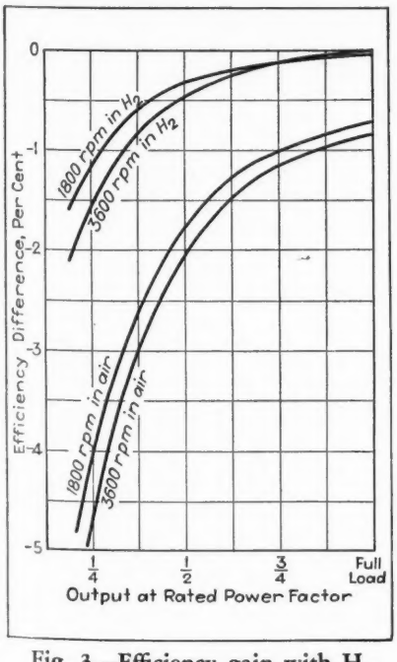



**Fig. 3—Efficiency gain with $H_2$**

In filling the casing with hydrogen initially, the possibility of having an explosive mixture is avoided by first displacing the air with an inert gas, such as carbon dioxide. A mixture of about 70% $CO_2$ in air is obtained before the hydrogen is admitted. Also, when removing the hydrogen from the machine, carbon dioxide is first introduced until a mixture of about 90% $CO_2$ in hydrogen is obtained. This mixture is then removed by admitting air to the casing.

To provide against failure to follow defined procedure, or any failure of the equipment which could result in an explosive mixture, the frame is designed to withstand the force of a hydrogen explosion. Tests have indicated that the maximum pressure developed in the casing of an electrical machine completely assembled with rotor, windings and coolers, following the ignition of the most explosive mixture of hydrogen and air (30% hydrogen in air), would be about 50 lb. An explosion occurring at the upper limit of inflammability of a hydrogen-air mixture would produce about one-half this pressure. Frame and end shields of hydrogen-cooled generators are designed to withstand 250 lb without permanent deformation.

Hydrogen-cooled generators differ from air-cooled machines chiefly in that the welded casing is usually cylindrical in shape (to resist explosion pressure); the coolers are located within the casing, and so do not sacrifice the strength of the thick outer-wrapper plate. A shaft seal is provided and special precautions are observed in the frame construction to secure gas-tightness. Welded joints are made with special care, and are separately tested for gas leakage. Leakage at flanged joints is prevented by a machined groove within the bolting line, containing a heavy, viscous compound. Outside end-shields are either of fabricated or cast-steel construction, in the latter case being copper-brazed to seal the pores against gas leakage.

Most of the hydrogen-cooled generators built by the General Electric Company have four gas coolers located entirely within the stator casing with their long axes parallel to the horizontal axis of the generator. The cooler tubes are accessible through the water boxes for cleaning without losing hydrogen from the casing by removing outside plates. One cooler at a time may be cleaned with the generator in operation, load first being reduced to about 80% normal. In most installations, raw water is used in the coolers, although in some cases distilled water is employed and a heat exchanger external to the machine is provided for cooling the distilled water.

## Arrangement Details

A water-detecting device is connected to the bottom of the casing and operates an alarm if water starts to collect. The device also serves to detect leakage of oil into the machine from improperly functioning shaft seals.

The 40,000-kw Logan generator employs a novel cooling system in which cooling water is circulated through hollow metal "pads" sandwiched between stator laminations. An external heat exchanger cools the distilled water circulated through the "pads".

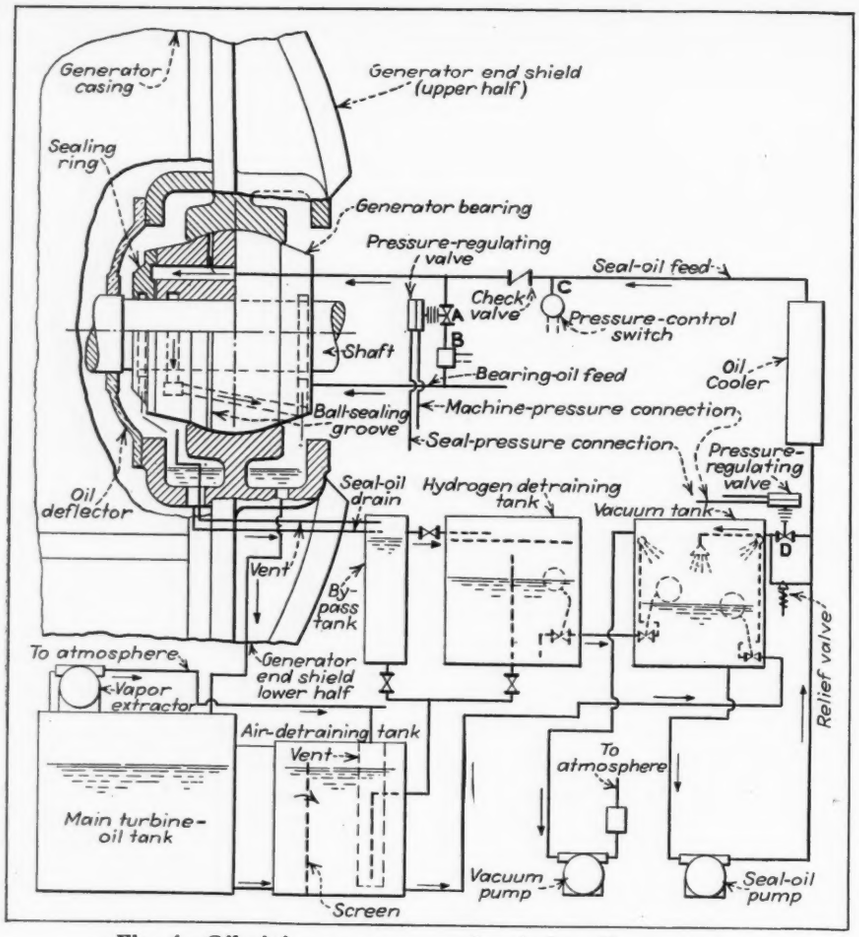



**Fig. 4—Oil-piping arrangement for shaft-sealing system**

Ventilation is usually provided by 2 fans, mounted one on either end of the rotor. The 150,000-kw State Line generator, however, has four motor-driven fans mounted in the top of the stator frame and driven by vertical-type induction motors housed in explosion-proof domes. Two coolers, instead of the usual four, are provided with this generator, mounted one on either side of the stator casing. They are parallel to the horizontal axis of the machine, the outside casing being built eccentric with the inside stator structure to provide space for the extra-large coolers and necessary ventilation passages.

The shaft-sealing arrangement is illustrated in Fig. 4. A sealing ring attached to the generator side of each bearing, concentric with and of the same bore as the bearing, contains an annular feed groove to which oil from the sealing system is supplied under pressure. From this feed groove oil passes axially along the shaft in both directions to two release grooves, one in the sealing ring and one in the bearing, into which it is deflected. The oil film thus created in the constricted sections between the feed groove and release grooves completely surrounds the shaft and constitutes the shaft seal. By maintaining the oil pressure in the feed groove somewhat higher than the hydrogen pressure in the casing, the shaft may be effectively sealed against leakage at any hydrogen pressure.

As oil flowing from feed groove to release grooves is subjected to centrifugal forces induced by shaft rotation, entrained gas would be largely given up to the gas in the casing and to the bearing oil. For this reason oil supplied to the feed groove is first vacuum-treated to remove practically all traces of air or hydrogen, which might act to reduce the hydrogen purity in the casing, or to introduce hydrogen into the bearing lubrication system. By maintaining a vacuum of about ½ in. Hg (absolute) in the vacuum tank of the oil-treating system, a hydrogen purity of approximately 97% is maintained in the generator at all times, and the amount of hydrogen entering the bearing lubricating system is insufficient to produce an explosive mixture at any point in this system.

Oil flowing to the hydrogen side of the seals is deflected into the seal drain, whence it passes into the hydrogen-detraining tank. Here the larger globules of hydrogen, absorbed by the oil flowing from the seals, are given up and pass back into the generator. From the hydrogen-detraining tank the oil passes into the vacuum tank, where practically all remaining hydrogen is removed. Oil flowing to the air side of the seals unites with the bearing oil and enters the main oil tank, whence an equal amount flows by gravity into the air-detraining tank. Here the larger globules of air contained in the oil as it comes from the bearings are given up. From the air-detraining tank, the oil passes into the vacuum tank where remaining air is removed. Float-valves in the vacuum and hydrogen-detraining tanks maintain constant oil levels.

Oil is pumped to the seals from the vacuum tank by a rotary pump having a capacity several times normal seal flow, excess over seal requirements being diverted back into the vacuum tank through pressure-regulating valve *D* (Fig. 4). This valve maintains seal pressure at a constant differential with respect to the hydrogen pressure in the casing. The oil bypassed into the vacuum tank enters through spray nozzles which serve to expose large areas of the oil to vacuum treatment.

### Emergency Seal Supply

To ensure an uninterrupted supply of oil to the shaft seals in the event of failure of any part of the oil-treating system, pressure-regulating valve *A* (Fig. 4) is provided, through which oil may be supplied to the seals from the bearing-lubrication system. Valve *A* is normally open but is prevented from supplying oil to the seals by the normally-closed solenoid-valve *B*, in series. Any failure in the oil-treating system which would act to reduce the discharge pressure of the seal-oil pump will cause the pressure-control switch *C* to operate, opening solenoid-valve *B* and allowing valve *A* to hold pressure at the seals.

Operation of the shaft seals with oil from the bearing-lubrication system will cause the hydrogen purity in the casing gradually to decrease, as a result of the liberation of air from the sealing oil. For an average machine this decrease amounts to about 1% in 5 hr and it is necessary to "scavenge" the casing at intervals with fresh hydrogen in order to maintain purity at a satisfactory value.

Under this condition of operation, oil containing some hydrogen passes from the hydrogen-detraining tank into the air-detraining tank and thence into the main oil tank. Operation of the vapor extractor maintains the atmosphere above the oil in the latter two tanks well below the lower limit of hydrogen-air inflammability.

The system of hydrogen control employed with these machines is illustrated in Fig. 5. The hydrogen supply is contained in several commercial bottles connected in multiple

through pressure-reducing regulators. A solenoid valve, operated by a pressure-control switch, admits hydrogen to the generator casing to maintain an approximately constant pressure.

In most hydrogen-cooled generators the pressure in the casing is held between 8 and 12 in. of water, sufficient to avoid leakage of air into the machine and yet as low as practicable. Some machines, however, are arranged to operate at hydrogen pressures up to 15 lb, to take advantage of the improvement in cooling obtained at higher pressures. Increasing hydrogen pressure increases weight of hydrogen circulated per minute and thereby reduces the hydrogen temperature rise for given generator losses; also the rate of surface heat dissipation by forced convection increases almost directly with absolute gas pressure. The Logan generator, for example, operates normally with 85-F cooling water, and a hydrogen pressure of 8 to 12 in. of water. At certain periods in the summer, water temperature reaches 100 F. Hydrogen pressure is then increased to about 6 lb to permit operation at rated output without overheating the windings. Other generators, now under construction, will operate on power systems which occasionally require unusual amounts of reactive kva. At these times, hydrogen pressure can be increased permitting increased kva output for the same winding temperature.

A solenoid-operated scavenging valve is provided at the hydrogen-detraining tank, which permits discharge of hydrogen to atmosphere to increase hydrogen purity in the casing. Operation of the scavenging valve lowers hydrogen pressure causing the gas-feeding device to admit fresh hydrogen.

The automatic equipment and hand valves for controlling admission of hydrogen to the casing are contained in the control cabinet usually located on the operating floor, near the generator. An instrument panel on the front of the cabinet carries various indicating instruments required for operating the generator in hydrogen, the alarm-signal lamps and switches, and the scavenging-valve switch. The different instruments, with the exception of the fan-pressure gauge, are provided with contacts which operate the alarm system.

## Automatic Operation

Operation of the hydrogen-control and shaft-sealing equipment is for the most part automatic; the principal non-automatic operation is replacement of hydrogen bottles. Any abnormal condition is indicated by the alarm system in the hydrogen-control cabinet, which sounds a horn and lights a signal to indicate the faulty condition.

With the generator in operation the principal loss of hydrogen from the casing is due to absorption of hydrogen by sealing oil and subsequent evacuation of this oil in the vacuum tank. There is also a small amount of direct leakage through imperfect casing and piping joints and around valve stems. For three hydrogen-cooled generators now in service, average daily hydrogen loss is about 30 and 44 cu ft respectively for two 3600-rpm machines, and 120 cu ft for the 1800-rpm machines. These amounts of hydrogen cost $0.40, $0.99, and $1.20 per day, respectively. The unit cost of hydrogen varies from 1¢ to 2¼¢ per cu ft in the different localities.

In filling the casing with hydrogen about two machine-volumes of hydrogen and 1¼ volumes of $CO_2$ are required. When emptying the hydrogen from the casing, about two volumes of $CO_2$ are needed. Hydrogen and $CO_2$ required for one filling and emptying, for the above three machines, costs $55, $75 and $120, respectively.

## Conclusions

Several months' operating experience with four generators has indicated that, although they require at first somewhat more supervision than air-cooled generators, with increasing familiarity with the operation of the various auxiliaries, no greater operating difficulties are experienced than with air-cooled machines. Auxiliary equipment performance has been entirely satisfactory, and indicates that, with reasonable attention, a high degree of reliability may be expected from the hydrogen-cooled machine. In all cases anticipated benefits from hydrogen cooling have been realized, and are felt to justify the large amount of development work that preceded the introduction of this new-type machine.

The future of the hydrogen-cooled turbine generator will depend largely upon the trend in turbine construction. If the present trend toward large high-speed units continues, hydrogen cooling will be increasingly used. Smaller sizes, however, will continue to be built for air cooling, since with these machines increased efficiency with hydrogen cooling is largely offset by the increased cost. In general, hydrogen cooling for turbine generators may be considered economical for generators in capacities of 25,000 kw and above, at 3600 rpm, and 60,000 kw and above, at 1800 rpm. For these capacities, the power saving is usually sufficient to justify the additional expense.

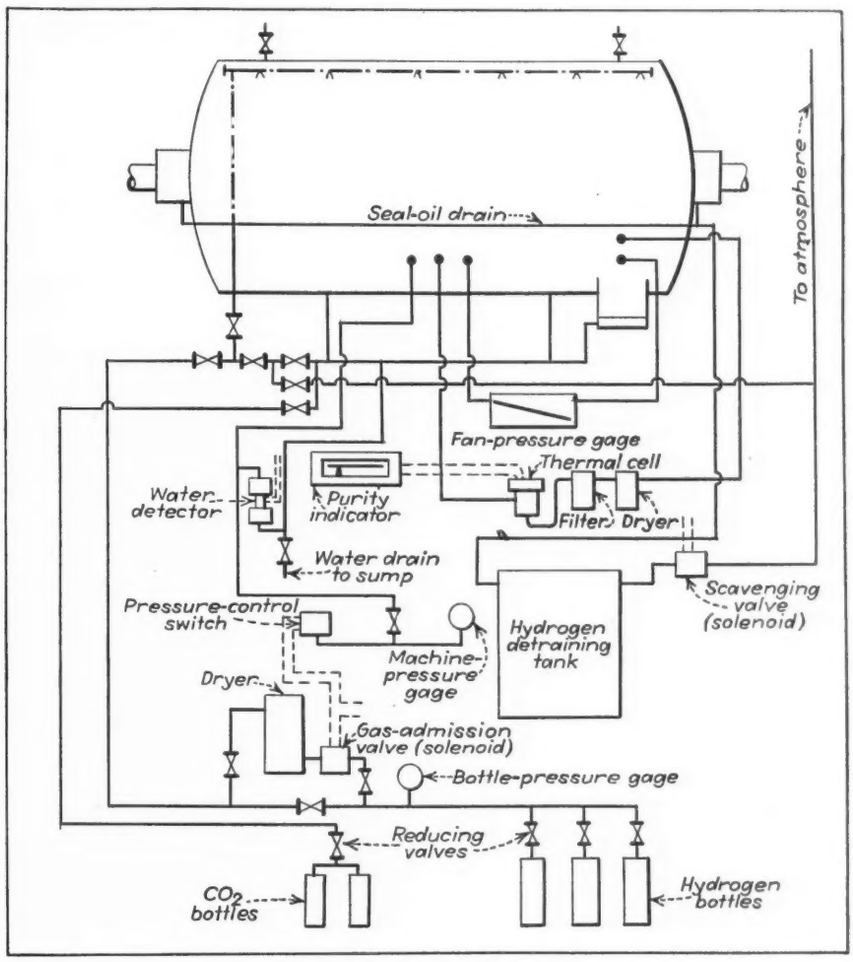



Fig. 5—Gas-control system

# Philip Morris Calls for Steam

## This new pipe-tobacco processing plant in Richmond, Va. leans heavily on controlled atmosphere, modern steam and power services

STEAM is as necessary to tobacco processing as tobacco is to holding steam pressure, by way of the engineer's pipe. Cruising through tobacco country, the editor dropped in on Philip Morris & Co, Ltd, for an experimental pipeful of the experts' own blend, and stayed to learn more about controlled atmosphere and the last word in pipe-tobacco processing.

The new factory pictured is across the James River from the famous "Factory No. 21 of Virginia," on the outskirts of Richmond. This 4-story, block-long building of modern brick-and-glass construction will be devoted to processing Bond Street and other Philip Morris pipe tobaccos. Glass-brick construction lets in light, results in pleasing exterior appearance and also has good insulating qualities for more efficient air conditioning. High humidity is required in many of the processing rooms.

Tobacco enters the plant in large wooden hogsheads after four or five years of aging. Because it then contains only about 10% moisture, it is far too dry to handle without crumbling. A first step is to increase the moisture content of the leaf to about 17%. This used to be done by storing several hundred hogsheads in a "sweat room" for at least five days at 100 F and 80% humidity to allow moisture to penetrate through two feet of tightly packed tobacco leaf.

With the aid of steam jets, the same process is now completed in 25 minutes in one-tenth or less of the space formerly required. The equipment, product of Richmond, Va., is called "Thermovactor," and consists of two large vacuum chambers and a 3-stage steam-jet evactor. Five hogsheads are rolled into one of the chambers and the doors sealed. Five minutes later the steam jet has drawn a vacuum of 29.85 in. of mercury, only 0.15 in. above perfect vacuum. Steam is then admitted through a three-inch line and penetrates quickly into the packed leaf. Proper timing and control produces the right degree of moistening.

### Air-operated Valves

A pilot-operated valving arrangement permits loading one chamber while the other is being evacuated. Operation is nearly automatic; compressed air serves control equipment and power cylinders.

The next process, removing the stems, is carried on in an atmosphere of 55% humidity to maintain high moisture content of the leaf. The entire upper floor, stemming and blending rooms, is air conditioned by two units, one of which is shown in Fig. 3. Air is drawn in from the roof by two motor-driven V-belted fans. One part is humidified by water spray, and heated or cooled as needed, depending on outdoor conditions. The other portion, tempering air, is drawn through the other fan. Each fan supplies its own duct system with distribution

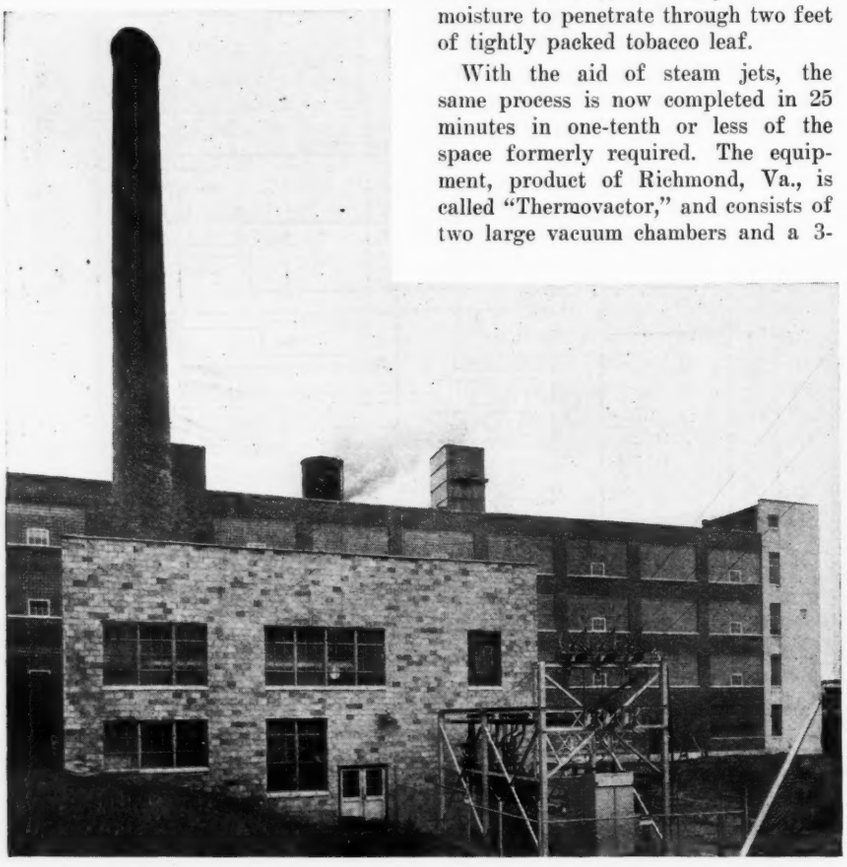


**Fig. 1—Neat appearing boiler house in foreground serves glass-and-brick, 4-story, block-long, air-conditioned factory**

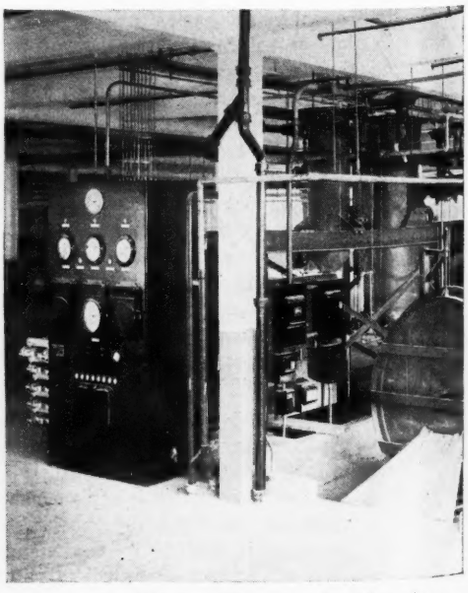


**Fig. 2—Vacuum chamber does better in 25 minutes initial**

points throughout the room, control of final temperature and humidity being obtained by varying the proportion of air through each fan. Other parts of the building, except the shipping room, are completely air conditioned. Supplementary humidifying is done by direct spray with compressed-air atomization at each spray nozzle.

### Separate Boiler House

The steam plant is in a separate building a few feet from the factory. Steam and water lines, compressed-air piping and cable conduit cross below ground level in a tunnel. Two 2025-sq-ft B&W Stirling boilers are designed for 450-lb working pressure for power generation at a future date. They are now operated at 125-lb pressure and power is purchased.

Coal is delivered by rail to a storage yard close to the boiler room and will be brought in to the single-retort Westinghouse stokers by a conveyor, soon to be installed. Forced-draft fans are motor driven.

Most of the condensate from process and factory is recovered and returned to a supply tank below the boiler room. Makeup is treated and added as needed, obtained either from the city supply or from a deepwell. An open heater is supplied with steam exhaust from boiler-feed pumps, any deficiency being made up from the main-steam header under control of an automatic valve.

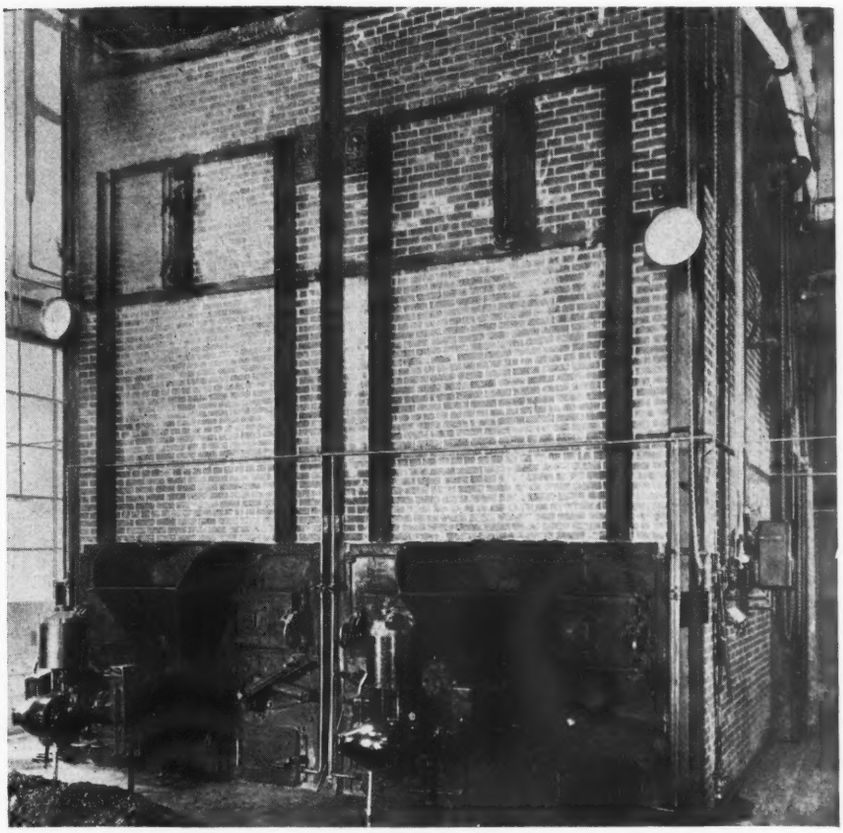
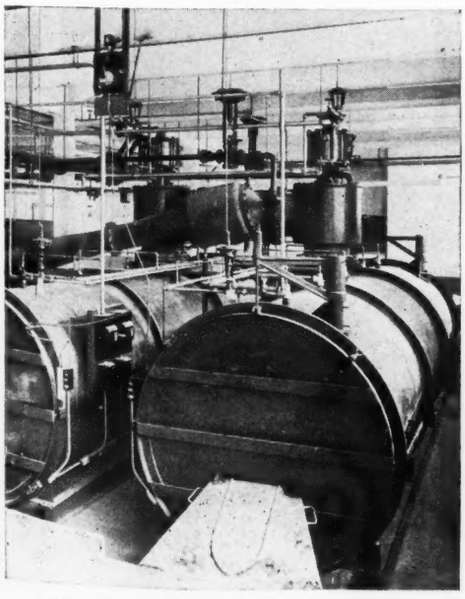


**Fig. 4—Boilers are designed for 450 lb for future power generation**

Other services are also supplied by the power plant. Two air compressors supply separate systems; one for operation of control equipment and valves, the other for spray atomizing. Two Vilter ammonia compressors, V-belted to 75-hp motors supply 150 tons of refrigeration effect. A high-pressure hydraulic hogshead press is served by a separate pump.

Wrought-iron pipe is used for water and air services. Neatness of appearance and simplicity of piping arrangement have been achieved by the use of copper tubing with solder fittings for many small lines.



moistening that used to take ten days. Saves space too.

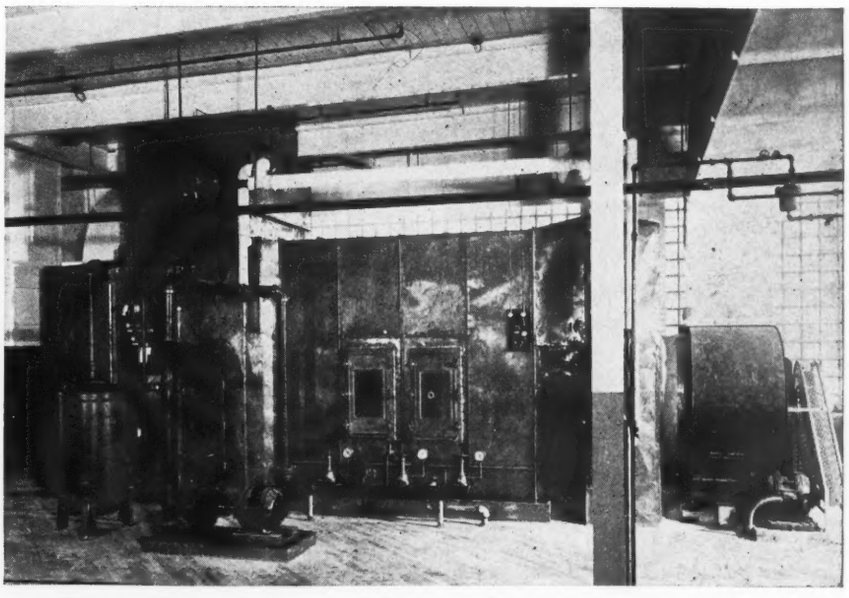


**Fig. 3—Three of these conditioning units control temperature and hold humidity above 50% in stemming and blending rooms**

# Today's Diesel Practice—

## *Oil Purification Systems*

Modern diesels deserve clean oil—here's how typical Southwestern plants handle the purification and reclamation of lube and fuel oil

By ORVILLE ADAMS

CLEAN OIL is a practical necessity in any diesel plant, and most plants have equipment of one kind or another for removing contamination. A survey of modern plants in the Southwest indicates that there is enough difference between details of methods employed to make worthwhile a description of some typical systems and a discussion of their advantages and disadvantages.

In most plants, both lubricating and fuel oil are filtered through metallic or cloth screens, or activated clay. Filters like those in Fig. 1 are almost universally used, regardless of other, additional purification methods. In most plants, also, storage or sump tanks are utilized to effect some separation by gravity settling.

Where fuel oil is further purified by centrifuging, continuous operation is customary. Of the two general methods of lubricating-oil purification, the batch system and the continuous-bypass system, the latter is more commonly used today. In batch treatment, chemical coagulants may be used to separate contaminating substances; for some years centrifuges were largely used in connection with this system, and the arrangement is still found in many older plants. Present practice seems to favor continuous centrifuging of a part of the oil, drawn from the system through a bypass. While the entire circulation of lubricating oil could be centrifuged, an extremely large unit would be required with a consequent marked increase in cost.

One arrangement of the bypass system is illustrated in Fig. 3. Lubricating oil, pumped to the overhead tank, flows by gravity to the engine. The centrifuge takes oil from the bottom of the tank and returns clean oil to it. With gravity flow from tank to centrifuge, the two pumps usually associated with the continuous system are not needed. In the arrangement shown in Fig. 2, however, both pumps are necessary. A pump on the centrifuge draws oil from the sump tank alongside and the second pump delivers clean oil to the engine or to an overhead tank for gravity feed to the lubricating system. In this plant both tank and centrifuge are in the basement. Another way to eliminate a second pump is to locate the centrifuge on a platform for gravity flow to the lubricating system.

Centrifuges are sometimes arranged to handle oil from two or more engines, but this practice is not general, and practical considerations usually require that each centrifuge serve only one at a time. While this does not necessarily mean one to each engine in the plant, need for flexibility in most plants is such that it amounts to that.

In the Denton, Texas, plant for ex-

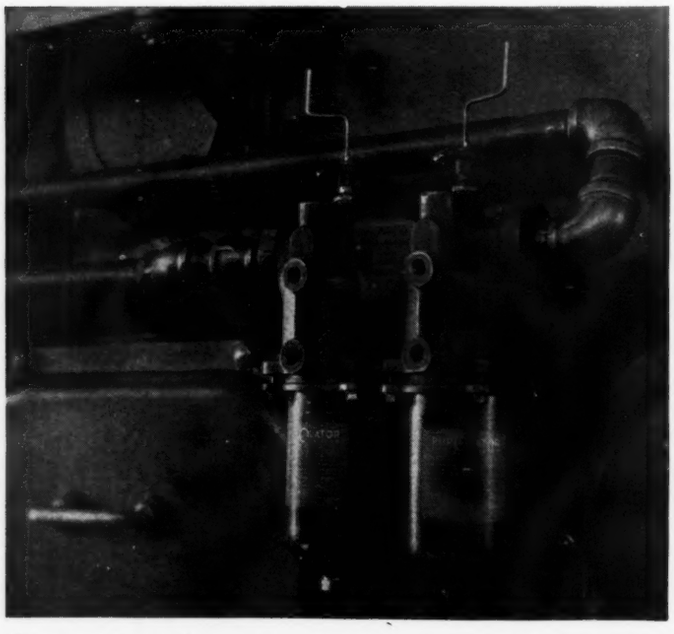


Fig. 1—These filters clean fuel oil for a 1000-hp engine at Denton, Texas, municipal plant

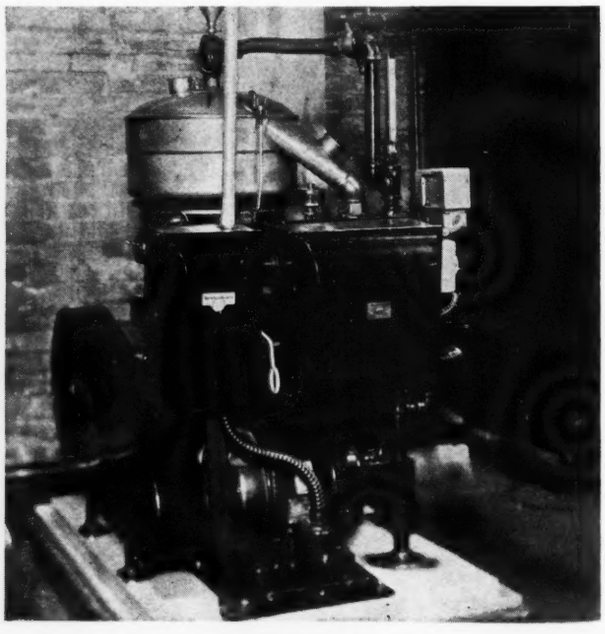


Fig. 2—Two pumps are needed with this basement arrangement at Greenville, Texas, municipal plant

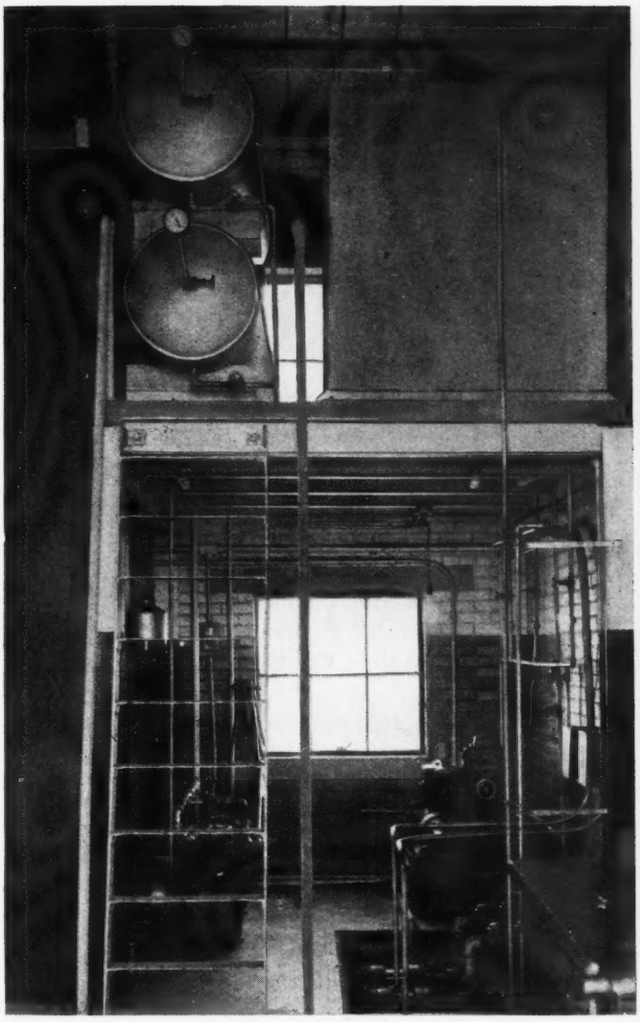


Fig. 3—Centrifuge draws from overhead tank and single pump returns clean oil—Cooper, Texas, municipal plant

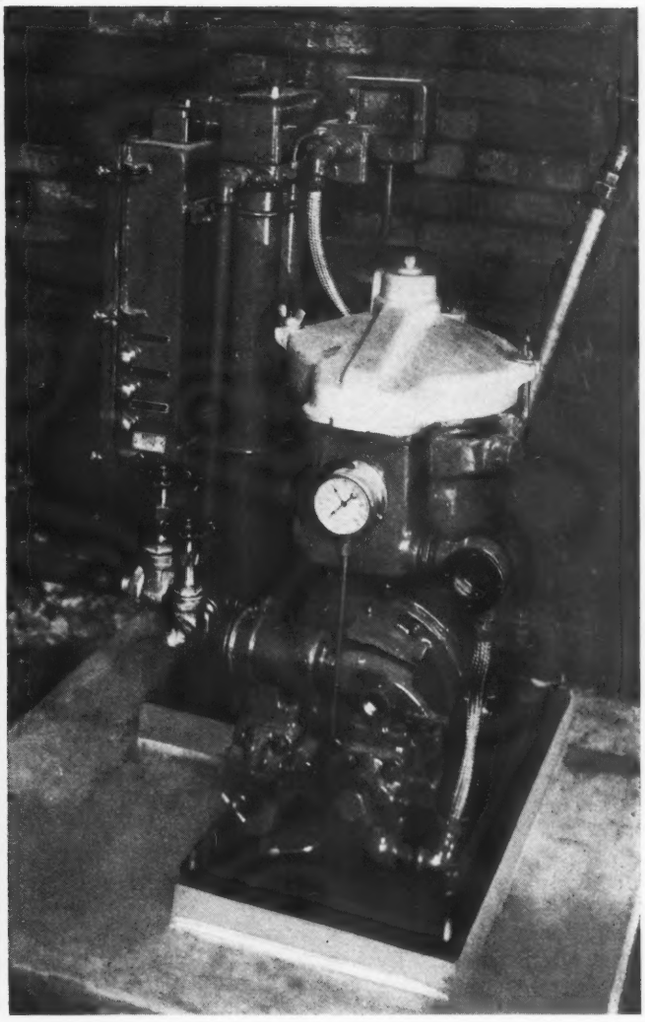


Fig. 4—Heater combined with centrifuge unit—Gainesville, Texas, waterworks

ample, each of the five 1000-hp engines is served by its own centrifuge, located adjacent to the engine, and usually on the opposite side from the operating devices. A sump tank under the engine-room floor receives oil from the engine, and a pump on the centrifuge draws oil from the tank for purifying. Another pump delivers clean oil to the engine. Although one centrifuge might have been used for a pair of engines, such an arrangement would have meant complicated piping and loss of flexibility, a serious matter to the operator.

In another case, making a centrifuge serve two engines at a time out of a set of three has proved rather unsatisfactory. When engines were new, no more than two were ever operated at one time, and purifier capacity was adequate. Now, however, it is sometimes necessary to run all three units on peak loads, and the centrifuge cannot remove contamination as fast as it accumulates in the system. Here experience has definitely shown the need of one or more additional centrifuges.

Multiple use of centrifuges may work out well under favorable conditions, however. This is illustrated at the plant of the Standard Tilton Milling Co, which is equipped with a 585-hp and a 750-hp engine. Both are air-injection units burning the cheapest grades of oil available (1 to 1.5 cents per gal.). Only one engine is operated at a time, the units being alternated at 30-day intervals. The arrangement is such that the centrifuge of the operating engine is used on lubricating oil, while the centrifuge serving the other engine is used for fuel cleaning. This procedure has given good results; fuel and maintenance costs are low.

## Centrifuge Capacity

Apart from physical arrangements, which differ considerably as the plants described illustrate, the survey called attention to several other factors involved in purification. One of these is the importance of installing a centrifuge of adequate capacity. According to some authorities, effective capacity in gallons per hour should be equal to brake hp divided by 6, if oil is to be centrifuged at 140 F. Brake horsepower should be divided by 12, if centrifuging is at 180 F. Another rule of thumb puts it this way: capacity should be such that the volume of oil centrifuged in 6 hours will equal the total volume being circulated. While purifiers can handle oil faster than the effective rate, it is not practical to do so. Good results cannot be obtained with an undersized centrifuge, as cleaning frequency will be increased. Centrifuges are inefficient when the bowl is more than half full of precipitation; capacity of the bowl should be sufficient to permit cleaning at the end of the day's run.

Centrifuging effectiveness depends on oil viscosity and thus on temperature. Many modern centrifuges have heaters incorporated with them (see Fig. 4). In other installations a separate heater is employed. Electric heating is common, but steam, hot water, gas, or oil may be used. In some cases, exhaust gas or jacket water heats the oil, utilizing heat that would otherwise be wasted. Although in such cases byproduct heat is used instead of a valuable product such as elec-

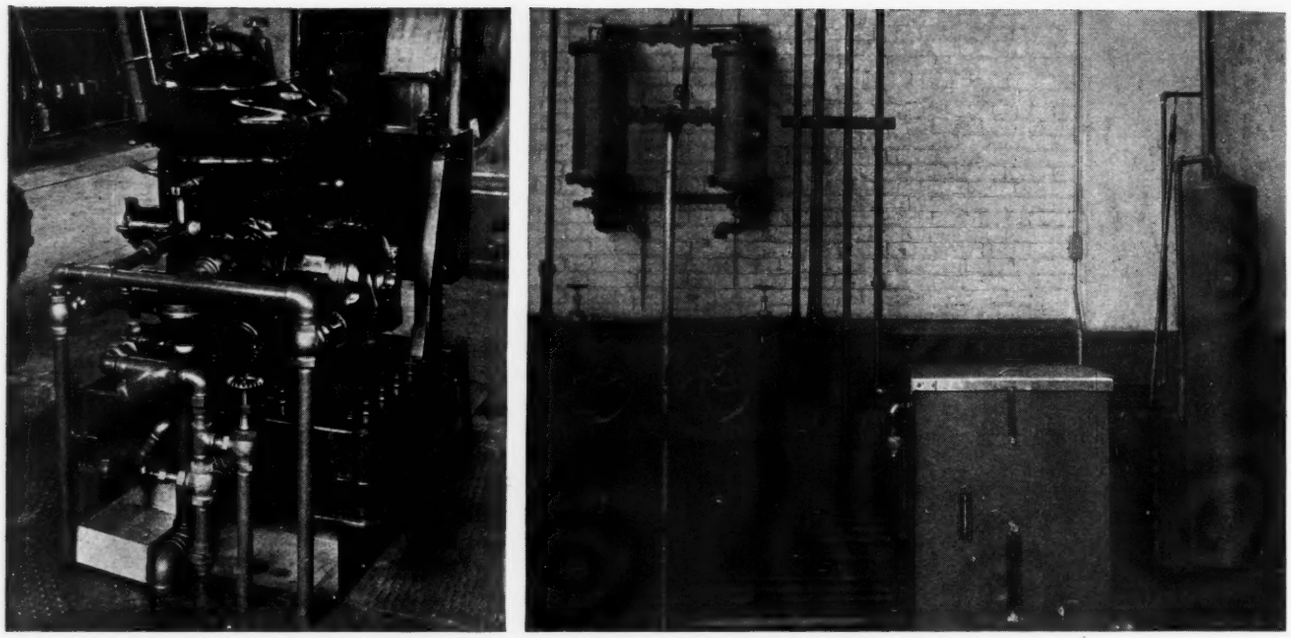


**Fig. 5—Centrifuge, tanks, and filters at Standard Tilton Milling Co, Dallas**

tricity or steam, more engineering is involved and installation costs may run higher. As a general thing, choice of method of heating rests on convenience rather than on operating cost.

In the majority of plans surveyed, working under severe climatic conditions, lubricating-oil coolers lower the temperature of the oil as it comes from the centrifuge. These units are usually located just after the purifier, and before the oil is delivered to the clean-oil tank.

Centrifuges do not remove certain sludges that discolor oil, and do not remove all fuel dilution, colloidal carbon, and oxidation products. It is general practice to drain the lubricating system annually and replace with new oil. In plants like that at Denton, Texas, this means replacing 2000-2500 gal. of oil, an expensive process. For this reason, interest in oil-reclaiming methods has long been active.

Recently the Denton plant purchased a reclaimer which, according to the engineer in charge, is expected to pay for itself each year by the oil it will save. Dirty oil is pumped to the heating chamber of the reclaimer by an internal gear pump, operating under float control. Filter earth is added, and an electric heater, thermostatically controlled, heats the oil to the desired temperature, while the oil and clay mixture is being agitated continuously. Heating requires about 1.5 hours, then the thermostatic control shuts off the heater, which is a signal to the engineer that a batch is ready for filtering. During the heating, at temperatures as high as 400-500 F, light oil fractions, fuel dilution and water are vaporized and vented. A motor-driven pump forces oil and clay through the filter press, at a pressure of about 30 lb. Clay collects on the filter-press blotters forming an additional filter, which together with the blotters, removes all solid material from the oil. The process removes colloidal carbon and restores the oil to practically its original color. Oil containing additives is not used as this method removes most additives.

Thus use of reclaimers in plants having a number of engines may be both practical and economical. When oil should be reclaimed is usually something for experience to decide. In the opinion of some operating engineers, oil should be reclaimed when it has increased in viscosity by 10-15%.

✦ ✦ ✦

# *Questions for Boiler-Room Engineers*

By Harry M Spring

*Q—What is safety factor of a boiler?*
A—It is the ratio between the maximum allowable working pressure and the bursting pressure.
*Q—What possible connections would you make to a boiler-water column?*
A—Steam gage, drain, damper or combustion regulator, feedwater regulator.
*Q—Why limit these?*
A—Any connection causing an appreciable flow of steam might cause a false water-level indication.
*Q—How would you prepare a boiler for inspection?*
A—Cool and drain the boiler. Remove all handhole plates, manhole plates, washout plugs, and thoroughly wash all internal surfaces. Clean heating surfaces. Remove steam gage for testing.
*Q—If you were to renew an elbow on the boiler-blowoff line for a 150-lb boiler, what material would you use?*
A—Extra-heavy steel.
*Q—Why not cast iron?*
A—Cast iron would tend to crack from possible shock in operation.
*Q—What is a hydrostatic test?*
A—It is a water pressure test applied to a boiler to detect possible leakage. Water temperature varies from 70 to 150 F, and water pressure is usually 1.5 times working pressure. The safety valve is held closed by a clamp or gag, and the steam connections are blanked off from the steam header. Pressure is controlled within 2%.
*Q—The upper tubes of a water-tube boiler leak at their expanded ends. The internal surfaces of the boiler and tubes are clean and in good condition. What is probable cause of leakage?*
A—Low water.
*Q—Where around a safety valve is a drain required?*
A—At the lowest point in the escape pipe where condensate can collect.
*Q—What is the purpose of the check valve on the feedwater pipe?*
A—To prevent water from the boiler backing-up through the feed pump.

# Dynamic Braking Gets Another Job

## Induction-motor-driven elevator-door operators modernized by replacing oil checks with dynamic braking using dc power on motor-stator windings

By H D JAMES
*Consulting Engineer, Pittsburgh, Pa.*

SATISFACTORY operation of elevator doors is important to good elevator service. Power-operated doors decrease time required for loading and unloading passengers, and insure positive closing when the elevator leaves the landing. In earlier designs, doors were air operated, but most are now electrically operated. Door operators may be divided into two general types:

1. Those using one engine for all floors, mounted at the front of the car top. Objections are that it makes the car loading off center and any slamming of the doors is transmitted to the car guides.

2. Those using a separate motor operator on each hatchway door. This reduces size of car-door operator mounted on top of car, but adds to initial cost.

Recent developments make it possible to modernize earlier types of motor-operated doors by changing the method of controlling the motor. One installation of 12 elevators was changed a year ago and is now performing as well as the best modern equipment. This modernized installation uses a single door operator for each car. The operators were driven by slow-speed induction motors and oil dashpots were used for checking the doors.

Initial movement of doors was satisfactory but trouble was experienced in stopping. Oil checks did not operate in a uniform manner, and became worse with wear. Best available oil was used in checks to overcome variations due to temperature changes, but it did not eliminate the trouble. Even with careful attention doors would slam at times and at others failed to close. These faults made it desirable to find some other means for checking door movement.

Dynamic braking can be obtained with an induction motor by connecting its stator winding to dc power, Fig. 1, and it was, therefore, decided to use this method for checking door movement and eliminate oil dashpots. After some experimenting, the arrangement proved very satisfactory. A new door controller, substituted for the old one, required no more space and used dc magnets which eliminated some of the previous trouble. Automatic landing equipment needed some attention. A voltage regulator added to the exciter, materially improved the landing and simplified the door control.

Door opening is initiated by the car control and the induction motor is operated, as before, in zone *A*, Fig. 2. Dynamic braking is applied at the proper point in the travel, zone *B*, which stops the door with sufficient accuracy for the open position. Door closing starts as with the previous system, but stopping must be exact so graduated braking was developed for this operation.

When closing doors, it is often necessary to make a quick stop to prevent hitting a passenger who steps in the doorway unexpectedly. Tests showed that reversing the motor did not stop doors quickly enough but that dynamic braking gave a quick stop.

On a cold winter morning the door mechanism operates sluggishly so that successful closing requires less dynamic braking. The control is therefore provided with two closing adjustments, switch *E*, Fig. 1, and means installed for changing from cold to hot adjustment when warmed up.

When a hatchway door is slammed shut with a door closer mounted on the front of the car top, reaction between doors and the closer is taken by the car guide rails, and tends to force these rails out of alignment. Continued slamming will make a poor running car due to irregular rails. It will also increase the maintenance on the door equipment as well as be annoying to building patrons.

No exact scheme of control can be offered for general application as differences in operating requirements, weight of doors, and existing mechanism, make it necessary to analyze each application and devise suitable details. It is probable that any ac-motor-operated door device now using oil or air checks can be changed to dynamic braking with marked improvement in operation if mechanical parts are put in good operating condition.

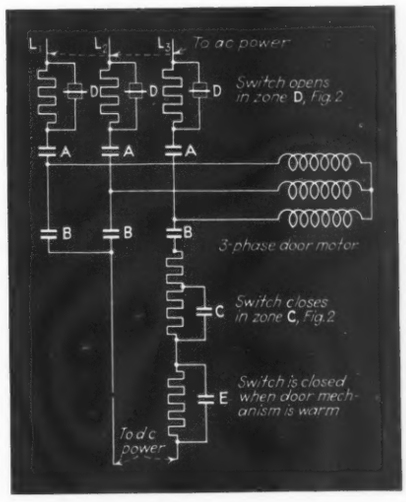



**Fig. 1—Simplified diagram of door-operator motor connections**

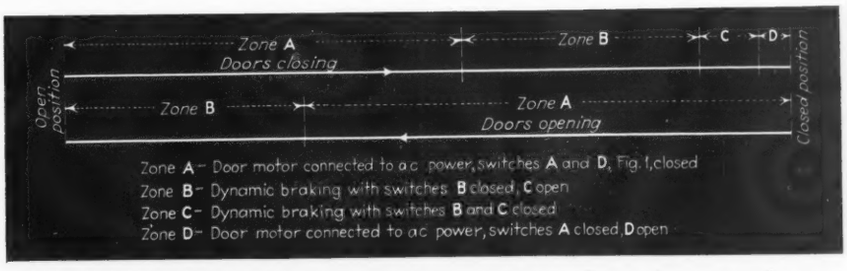

Zone A
Doors closing
Zone B
C
D
Open position
Zone B
Zone A
Doors opening
Closed position
Zone A- Door motor connected to a.c. power, switches A and D, Fig. 1, closed
Zone B- Dynamic braking with switches B closed, C open
Zone C- Dynamic braking with switches B and C closed
Zone D- Door motor connected to a.c. power, switches A closed, D open

**Fig. 2—Travel zones for elevator-door closing and opening operations**

# From an Operator's Log

## Seven short lessons in pulverized-coal-fired-boiler operation at Keystone Public Service Co

By W P SAUNIER
*Engineering Dept, The Utility Management Corp*

THE OIL CITY plant of Keystone Public Service Co put in service over a year ago a Foster Wheeler boiler of new design. Operating experience has brought to light a number of facts of interest and value to plant designers and operators. This article describes briefly the plant layout, the boiler and some of the operating experiences.

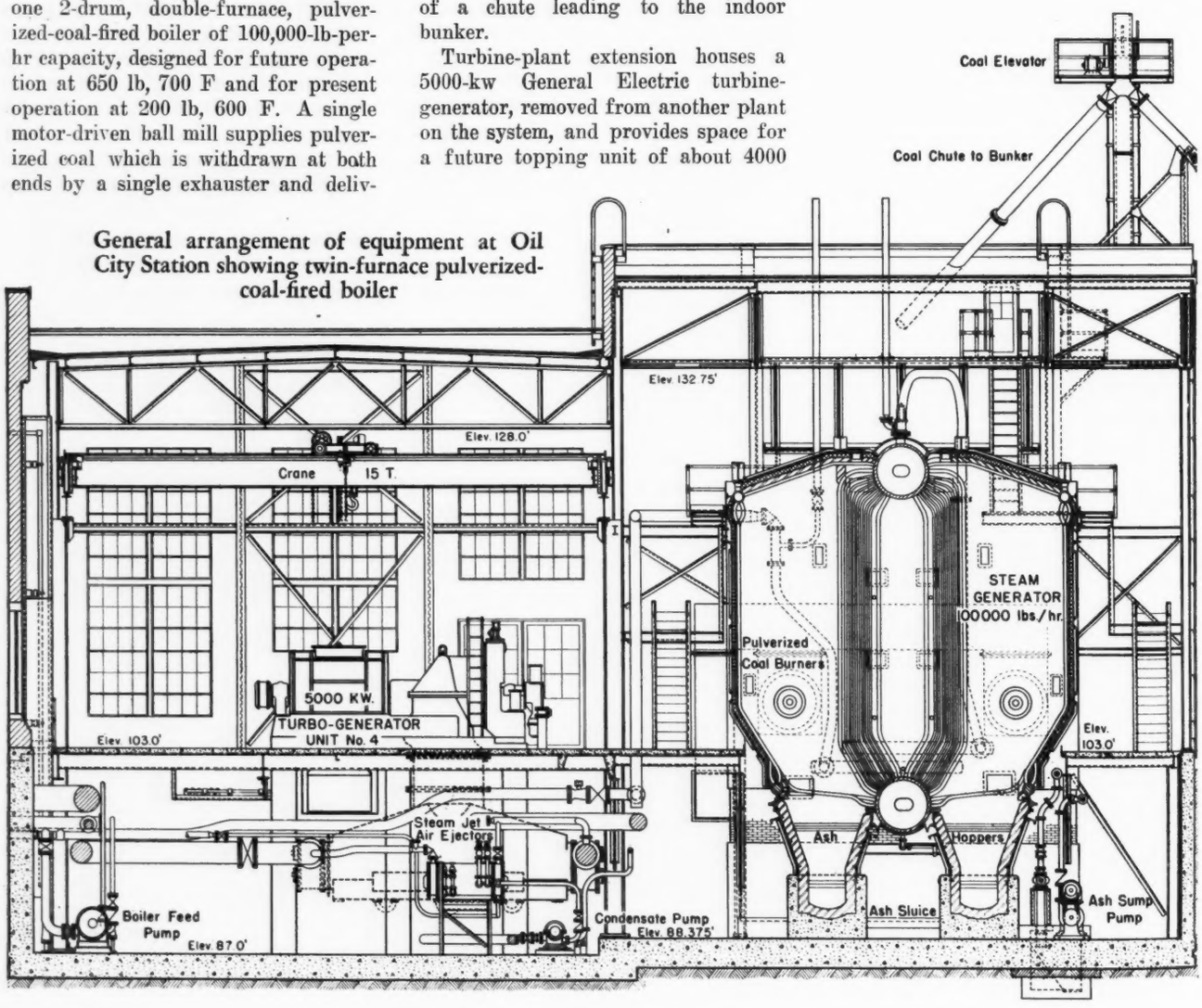
The boiler-plant extension comprises one 2-drum, double-furnace, pulverized-coal-fired boiler of 100,000-lb-per-hr capacity, designed for future operation at 650 lb, 700 F and for present operation at 200 lb, 600 F. A single motor-driven ball mill supplies pulverized coal which is withdrawn at both ends by a single exhauster and delivered to a single burner in each of the two furnaces. One motor-driven forced-draft fan supplies unheated secondary air to the two burners and a turbine-driven induced-draft fan exhausts flue gas to the stack. Raw coal from the bottom of a track hopper is taken by an apron conveyor to a high-speed crusher, from where it drops into the boot of an enclosed bucket elevator. The latter lifts the coal to the mouth of a chute leading to the indoor bunker.

Turbine-plant extension houses a 5000-kw General Electric turbine-generator, removed from another plant on the system, and provides space for a future topping unit of about 4000 kw to operate with steam at 650 lb, 700 F. The 5000-kw unit operates with steam at 190-200 lb, 600 F, supplied by the new boiler. Excess steam from the new boiler is desuperheated to about 520 F for use in the older turbines.

In the initial consideration of equipment for this plant, coal having a grindability index of 80 was considered standard; later detailed study indicated that a coal having a grindability index of 50 gave lowest fuel cost on a Btu basis.

### Increasing Mill Capacity

When the plant was started, it was possible to obtain only about 65% of design capacity using the low-grindability coal. The problem then be-




**General arrangement of equipment at Oil City Station showing twin-furnace pulverized-coal-fired boiler**

came one of increasing the grinding capacity of the mill to avoid paying a premium for coal having a higher grindability index.

Increasing mill capacity proved less difficult than anticipated, but required a number of changes and several months of effort. First, adding a surcharge of balls made a slight improvement. Then changes in the mill wear plates were made without much effect. The major increase was brought about by *decreasing* mill speed.

The mill is driven at constant speed by a 100-hp induction motor through a set of reduction gears. The motor was disconnected from the auxiliary supply bus and connected directly to a 5000-kw turbine-generator which had been cut loose from the main station bus. The turbine-generator was run at various controlled speeds down to 85% of normal and mill tests run for periods of several hours at these different speeds. The maximum mill capacity, with the coal being handled, was obtained between 10 and 15% below design speed. A new set of reduction gears for the proper ratio was purchased and installed in the original gear casing.

Later, experiments with a miniature mill indicated that greater capacity and mill stability could be obtained by feeding coal into both ends of the mill. This final change was made with the result that the mill can deliver sufficient coal of proper fineness to enable the boiler to steam at well over 100,000 lb per hr with stable mill operation under all conditions.

### Carryover

Several superheater tubes were lost after a few months operation and there were indications of considerable carryover. After calorimeter tests proved this, measures were immediately taken to reduce the moisture coming over with the saturated steam. The drum and its internal parts had been designed for operation at 650-lb pressure. It was evident that the baffles were not suited to the requirements of operation at 200 lb. Vertical slots were cut in the longitudinal baffle plates and impinging plates provided at small expense. Reduction in steam velocity entering the steam space in the drum reduced water entrainment and resulted in satisfactory steam conditions at all loads.

It is noteworthy that no circulation troubles have been experienced in boiler or waterwall circuits. This indicates that water circulation in all parts of the unit is satisfactory even though operation is carried on at less than one-third of the pressure for which the unit was primarily designed.

Surging in water level with load change, as indicated by gage-glass fluctuations, prompted an investigation. By using an old flowmeter rigged up to record water level and feed-regulator position simultaneously, the regulator was shown to be the source of surging in the drum. The regulator valve had internal parts large enough to pass three times the maximum water requirement of the boiler. Substitution of smaller internal parts resulted in complete cessation of drum surging.

Slag troubles encountered can all be charged against faulty operation and do not recur under proper operating control. During early operation, dust was permitted to accumulate on the furnace bottom shelves to such a depth that the top surfaces became pasty and large clinkers formed. Regular removal of the dust by each shift of operators, using conveniently located air lances, eliminated slag formation.

After six months, burners and secondary-air controls were adjusted to operate with minimum excess air. These adjustments were too optimistic. Slag built up on the rear furnace walls at the corners and also at the boiler slag-screen tubes. Increasing excess air to reduce the $CO_2$ content of the gas leaving the boiler to slightly less than 14% eliminated all hard-slag formation in the furnaces.

During severe winter weather, frozen coal created operating difficulties and threatened serious curtailment of operation. Fine particles of coal tended to build up into frozen masses at various points in the conveyor and elevator systems; moisture carried through with the coal was more than the primary air heater could cope with and maintain full mill capacity. A number of strip heaters attached to the conveyor frames and elevator casings at points where the fine coal was building up were effective. A unit heater supplied with steam was set up at the base of the coal elevator and heated air blown through elevator and chute leading to the bunker. The chief engineer reports that this heater is capable of removing approximately 25% of the difference in moisture between "as received" and "as fired." Since the installation of the heater we have passed through several periods when conditions were about as severe with respect to frozen coal as any that might be anticipated. Results have been satisfactory.

Our experience with pulverized-coal plants, dating back to 1923, had led to the conviction that men with no previous firing experience could most readily be developed as firemen and that men with stoker-firing experience were difficult to train and made poor firemen on pulverized-coal boilers. At this plant the local management wished to train the old-plant operators to handle the new equipment. Many of these men were middle aged and had operated stokers for many years. In spite of our doubts, we have found that the operating staff has learned to do a very satisfactory job in operating the new equipment.

✦ ✦ ✦

# Which Heating Value?

THE COMPLICATION introduced into work with gas fuels by the question of "higher" and "lower" heating values, is brought out again by a *Power* reader who asks that it be noted that gas-engine guarantees are based on lower heating value. Thus, if performance data for gas engines (as given on page 338, June *Power*), were to be converted from Btu per brake hp hr to cu ft of fuel per brake hp hr, the figures given would have to be divided by the lower heating value of the fuel to be used.

Why this difference? Because most gases contain hydrogen, and hydrogen forms water vapor when burned. In determining higher heating value, products of combustion are cooled back to original standard temperature, water vapor condenses, and latent heat of vaporization is recovered.

Since combustion products are rarely cooled enough to condense water vapor, it is claimed that the latent heat of vaporization should not be considered part of the heating value of the gas. The lower heating value thus differs from the higher by the latent heat of water vapor formed when hydrogen is burned. The difference ranges from 0 for gases without hydrogen to about 15% for pure hydrogen; for most commercial gases it is about 7-10%.

All fuels containing hydrogen, whether solid, liquid, or gaseous, and no matter how burned, have two heating values. Which is preferred depends on which industry is involved. Gas engine guarantees are commonly based on lower value, diesel engine on higher. The higher value is practically standard in all boiler computations. The answer is to know which value you are using, and why; then the difference will cause no trouble.

Fig. 1—*Los Angeles Times* building, said to be the first completely conditioned newspaper plant in this country

# Newspaper Puts Exhaust to Work

## Steam from power plant cools and dehumidifies, heats and humidifies completely conditioned newspaper building in Los Angeles

THE *Los Angeles Times* building carries the reputation of being the first completely air-conditioned newspaper plant in this country. Particularly noteworthy is the inclusion of the air-conditioning system in the heat balance of the building power plant; exhaust steam is used for cooling and dehumidifying, heating and humidifying.

The attractively designed building, Fig. 1, houses all departments of a modern newspaper including executive offices, editorial rooms, press and composing rooms, paper storage, and facilities for public gatherings (auditorium, model kitchens, dining rooms). The entire structure, having a floor area of 259,454 sq ft and a volume of 4,582,680 cu ft, is conditioned by equipment delivering 218,500 cfm of air that is maintained at 75 F, 55% humidity, year around.

General construction features of the building include extensive soundproofing, and thoroughly earthquake-proof design. Double windows with a 6-in. dead air space between panes prevent entry of street noises. The air-conditioning system has made it possible to utilize interior space and windowless offices without sacrificing comfortable working conditions. Air conditioning is also an aid in the handling and storage of large quantities of paper, sensitive to moisture.

To get a clear picture of the engineering of the air-conditioning system requires first an idea of the power-plant layout. Boilers, engines, and generators, occupying 95x116 ft at a level 35 ft below the street, are set on heavy reinforced-concrete foundations, insulated with lead, cork, and a small surface filler of asphaltum, to minimize vibration. Boiler pits are 5 ft 6 in. below engine-room level to prevent possible flooding of equipment.

Three 3000-sq-ft, natural-gas-fired Riley-Badenhausen boilers, operating at an average of 200% rating, generate steam at 200 lb and 540 F. Combustion is regulated by Bailey automatic control. Steam from the boilers supplies three Skinner unaflow engines direct-connected to 572-kva, 230-volt, 150-rpm generators with individual 125-volt, 165-amp V-belt-driven exciters.

As large quantities of dc are required for the huge newspaper presses, the plant has three 250-kw motor-generator sets, each driven by a 375-hp, 1200-rpm motor. A fourth motor-generator set, rated 30 kw, serves the general dc load when the large sets are shut down. Present load on the plant is close to 1500 kw. A 700-kw transformer bank, fed by the lines of the Los Angeles Bureau of Light and Power, serves as standby.

Power-factor improvement results from operation of the synchronous motors of the mg sets, which compensate for the lagging current of the induction motor load. An interesting arrangement to reduce starting requirements is a double-throw switch with its starting side across the utility lines and the running side on the power plant.

Central refrigerating and water-chilling equipment is also in the sub-basement. There are three 5-stage Carrier centrifugal-compressor units; two, of 195 tons capacity each, are driven by 220-hp, 3500-rpm, 2-stage, General Electric steam turbines; the other compressor, of 156 tons, is driven by a 165-hp turbine of similar characteristics. Turbines, on top of each compressor unit, take steam from the Skinner engines, at 5 lb, and exhaust to condensing equipment which maintains a 26-in. vacuum.

### Chilled-Water System

Water for air washers is chilled to about 40 F in the heat exchangers of the centrifugal-compressor units, and circulated by three centrifugal pumps with a total capacity of 1850 gpm, direct-connected to 3545-rpm induction motors. After use in the washers, water returns at about 47 F, and is held in four storage tanks. Thermostatic controls cut off refrigeration equipment if chilled-water temperature falls below 38 F.

Nine conditioning units, ranging in size from 10,400 cfm to 37,500 cfm, and located in the roof tower and on the third floor, receive chilled water from the basement refrigerating plant. Each unit consists of a preheater, a copper-lined washing chamber, reheating coils, and an Auditorium bypass. Air leaving the units is picked up by fans which discharge into the particular duct systems served by the units. A forced-draft cooling tower, 45 ft high, 51 ft long, and 21 ft wide, is in the roof tower of the building. Six fans driven by 10-hp motors move air through this 2400-gpm cooling equipment.

### Summer Operation

During summer months, air is drawn into the conditioners in amounts governed by thermostats in the intakes, mixed with a portion of the re-circulated air, and washed in a fine spray of chilled water. Entrained moisture is removed by eliminator blades, and the cold, saturated air is reheated before entering the fan chamber for distribution. Mixing with bypassed return air accomplishes some of the reheating; steam coils do the rest.

Fig. 3 shows the general arrangement for summer operation of the power plant and air-conditioning system. Water for condensing exhaust steam and refrigerant is circulated in the cooling-tower system by three 800-gpm pumps. Two 1735-rpm hotwell pumps driven by 5-hp motors handle condensate, and boiler feed is pumped by three $7\frac{1}{2}$x$4\frac{1}{2}$x10-in. duplex pumps. In winter months, exhaust steam from the engines is used for heating. Excess over heating requirements is condensed. Chilled-water and refrigerating circuits are shut down during the heating season.

The entire power plant and air-conditioning system is under control of the engineer through a master switchboard in the engine room. Gages show boiler pressure, exhaust pressure, vacuum, and water-storage levels. Recording instruments give data on steam flow in low-pressure headers, condenser-water flow, chilled-water flow, outside dry-bulb and wet-bulb temperatures, and temperatures in basement paper storage, press room and composing room. A centralized system enables the engineer to take quick readings, in the engine room, of temperature conditions at any one of 24 stations in various parts of the building.

Operation of the plant has been highly satisfactory thus far, and the use of exhaust steam for heating and cooling has resulted in a good heat balance, with large savings in operating cost.

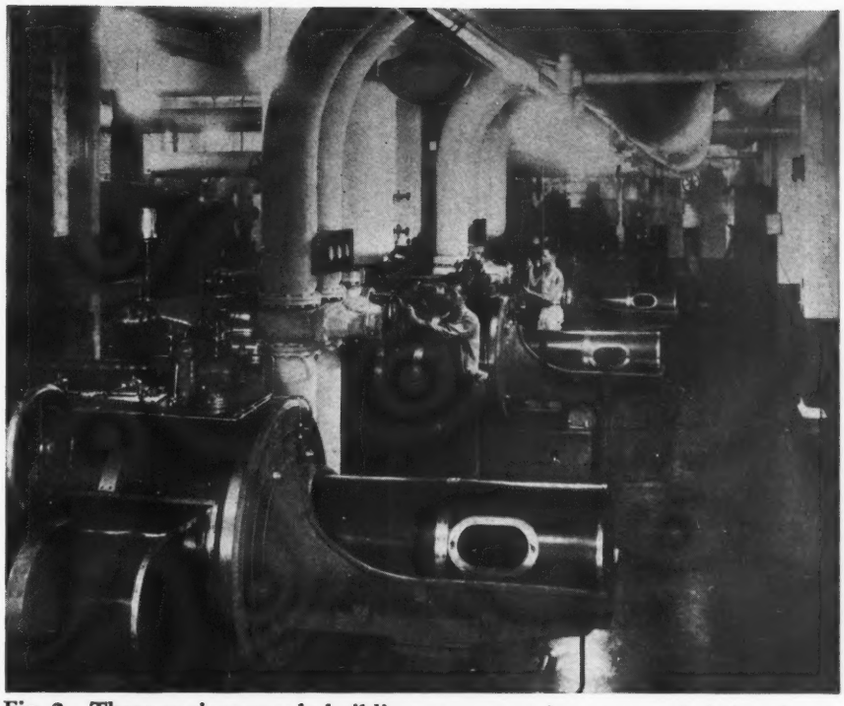


Fig. 2—These engines supply building power requirements, and their exhaust drives turbine-compressor units for air conditioning

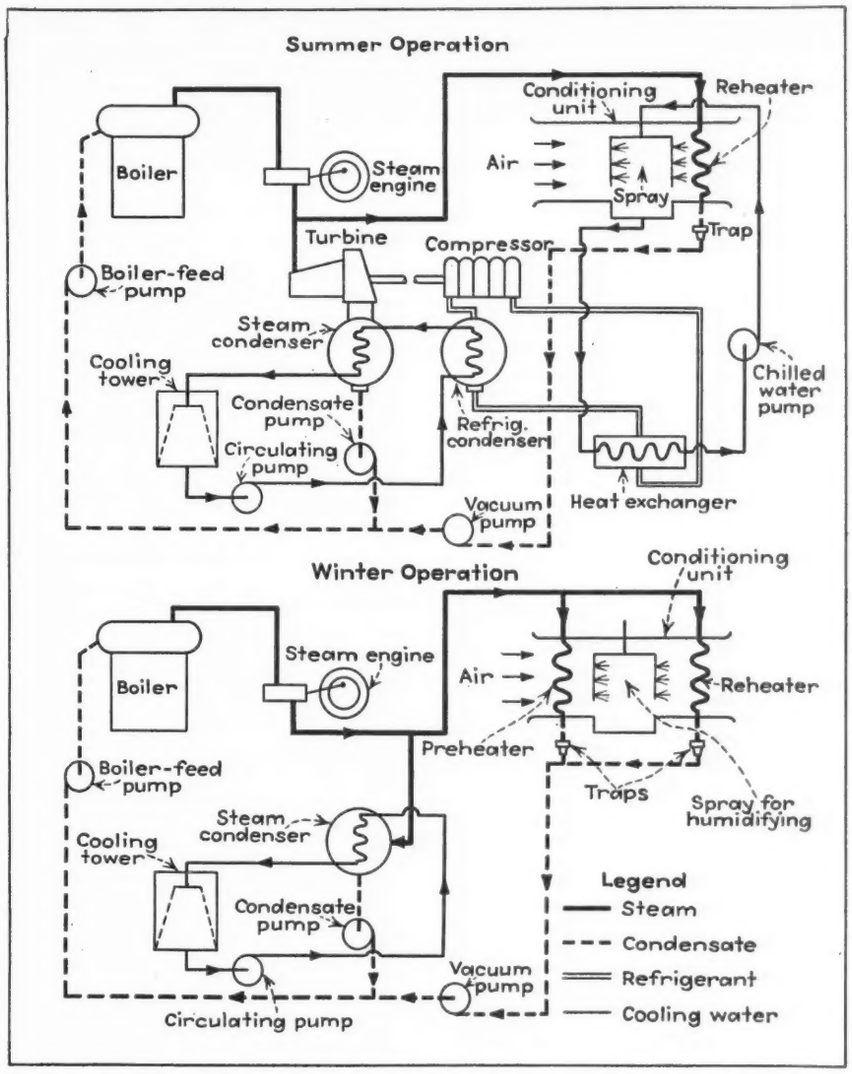



Fig. 3—Flow diagrams show how air conditioning and power equipment are combined in an economical heat balance

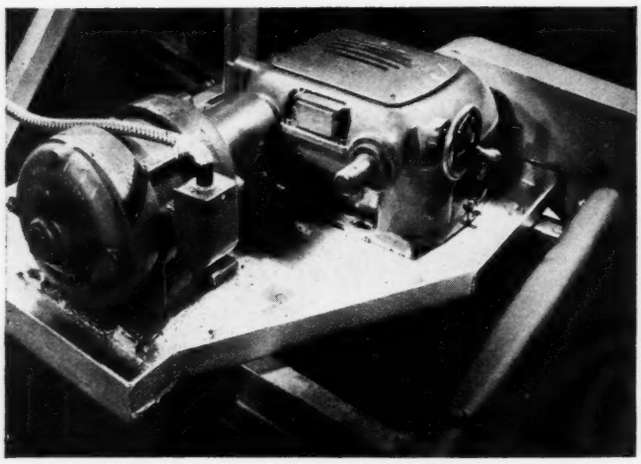


Fig. 1—A 2-hp, 1150-rpm motor and vari-pitch speed changer drives two conveyor chains at 2 to 5 fpm

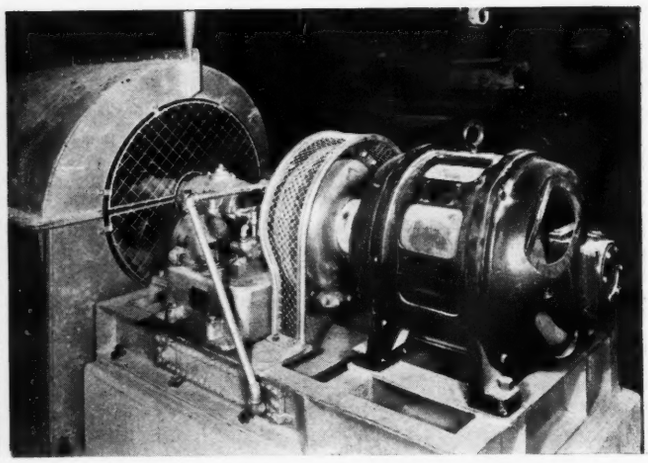


Fig. 2—Forced-draft fan driven by constant-speed motor and hydraulic coupling has speed range of 1 to 5

# Speed—As You Like It

## Variable-speed transmissions with simple squirrel-cage motors will meet most speed-adjustment requirements

POWER and industrial plants have a host of power applications that require adjustable-speed drives. For many applications, speed at which machines operate vitally affects quality and cost of production. Speed may have to be varied widely on the same machine producing different grades, sizes or shapes of products; rates of feed frequently have to be controlled over wide ranges; speed of two or more machines may require synchronizing; change in temperature or moisture content and many other conditions may make speed adjustment necessary. How these requirements can be met most economically depends upon several factors, such as kind of power available, required speed range, quality of speed control needed, etc.

Adjustable-speed dc motors will meet all requirements for many applications. General-purpose dc motors can usually have their speed increased 25% or more by inserting resistance in the shunt-field winding, without getting into commutator trouble. Adjustable-speed motors are available that will operate over a 1-to-6 speed range, say 300 to 1800 rpm, by field adjustment. Almost any speed range can be obtained by combining series and parallel armature-resistance control and shunt-field control. This also applies to variable-voltage control, but the equipment for this system is expensive and is generally economically justified only in medium and large power applications. In smaller wide-speed-range applications, a constant-speed motor with some form of variable-speed transmission device is most economical.

The real field for variable-speed-transmission equipment is in combination with ac motors. Synchronous and induction motors are essentially constant-speed machines, their speed being fixed by line frequency and number of poles in the motor. Wound-rotor induction motors may be slowed down to about 50% of rated speed by connecting resistance in their rotor circuit. For certain jobs where load decreases rapidly as speed is reduced, this type of motor finds an economical place. It is comparatively expensive, efficiency is low at slow speed and it is a less desirable machine than the simple constant-speed squirrel-cage motor.

Multi-speed induction motors are built for two or four speeds, such as 600, 900, 1200 and 1800 rpm, and for certain applications they meet requirements. Commutator-type polyphase motors are built for adjustable-speed use, but they are complicated, expensive and maintenance cost will usually be higher than with the simple constant-speed induction. Variable-voltage-control equipment may also be used but it has the limitations previously mentioned. A careful analysis will show that, for a large percentage of the small and medium power-transmission jobs requiring speed adjustment, where only ac is available, a simple constant-speed induction motor and some form of multi-speed or variable-speed transmission is the answer. This is becoming increasingly true as this equipment becomes more highly developed.

When a constant-speed squirrel-cage motor with mechanical-power-transmission equipment is selected, there are no restrictions placed on the choice of a motor. It is usually the one with the most economical speed for its size and the highest efficiency and power factor. Motor, speed reducer and variable-speed transmission can be built into a single unit and with control, may occupy less space than the adjustable-speed or multi-speed motor and control.

### Types of Equipment

There are several types of variable-speed transmissions that can give an infinite number of speed increments between a maximum and a minimum value. Such speed adjustment is obtained in the different mechanical types of transmissions by:

1. Sliding friction disks, by which

an infinite number of speeds can be obtained from a maximum down to zero, and reverse.

2. Flat belts on two opposing, parallel cone pulleys that may be shifted along the cones to vary speed between fixed limits.

3. V-shaped belts on V pulleys, the pitch diameter of which may be adjusted to provide a speed range as high as 16 to 1. With a special attachment, this type can be made reversible.

4. Multiple V-belts on a sheave, pitch diameter of which may be adjusted.

5. Planetary double-conical shaped rollers running in an adjustable race so that the rollers may be run on different diameters.

6. Planetary conical rollers operating within a ring that is adjustable axially along the rollers.

7. Tilting disk rollers running in concave-circular, driving-and-driven raceways.

8. Special devices, such as variable-throw eccentrics with constant-throw clutches, and other mechanical movements including sliding links and gears.

9. Multi-speed gear units with which two or more fixed speeds may be obtained by moving a speed-changing lever. These are available in compact combinations of high-speed squirrel-cage motor and gear unit to give four different speeds.

10. Hydraulic types combining a variable-displacement pump and a constant-displacement motor, or a variable-displacement motor. These are positive and will give a constant output speed for a given setting of the control, if input speed remains constant irrespective of load changes.

11. Hydraulic couplings, used particularly for loads such as fans and pumps. Here there is no mechanical connection between input and output element. The input part of the coupling acts as a pump to deliver fluid to the driven part, which performs as a waterwheel to drive the output shaft. Oil is the driving fluid and is circulated continuously through the coupling, output speed being regulated by control of oil flow. With the coupling full of oil, the difference between input and output speed is less than 3%. When the coupling is empty, its output half will rotate at about 20% of input speed when driving a fan.

Efficiency of variable-speed-transmission units varies with type and speed range. Some mechanical designs have a full-speed efficiency of 95%. As output-shaft speed is reduced, load and efficiency also decrease. Hydraulic types will have an efficiency of from 80 to nearly 90% for a wide-range, constant-torque load.

Variable-speed transmissions should not be judged by efficiency alone. There are other factors that must be taken into account, such as first cost, operating cost, speed-range control and adaptability of the unit to the application. When considering efficiency of variable-speed transmissions, don't overlook the fact that efficiency of adjustable-speed motors decreases as their speed is reduced. For example, efficiency of a wound-rotor motor decreases almost directly with speed when driving a constant-torque load. When power is purchased, the lower power factor of certain types of ac motors, operating at reduced speed may seriously increase power costs.

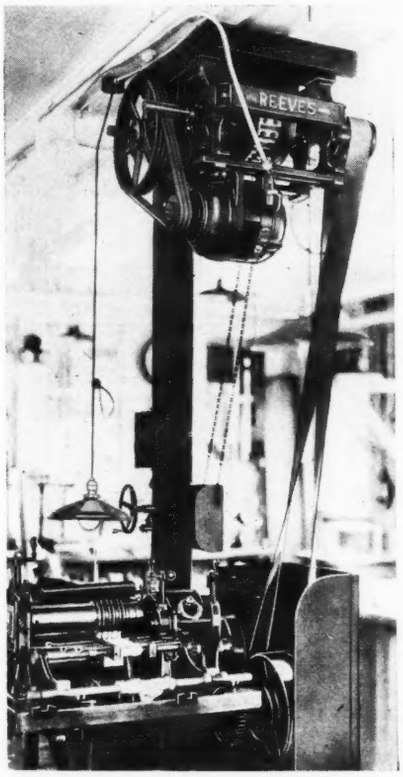



**Fig. 3—Ceiling-mounted constant-speed motor and variable-speed unit drives brass-slitting machine**

### Kind of Control

Output-shaft speed of variable-speed transmissions may be regulated by any form of manual, remote, or full automatic control. Speed may be adjusted over the full range in an infinite number of steps and remains constant for each adjustment, irrespective of load. However, with some types of variable-speed motors, speed adjustment is limited to the number of steps in the controller and speed is constant for any setting for constant loads only.

Subsequent articles will describe the operation of the several types of variable-speed-transmission equipment available and their applications.

**Fig. 4—7.5-hp vertical motorized variable-speed units driving sewage pumps, speed controlled by float**

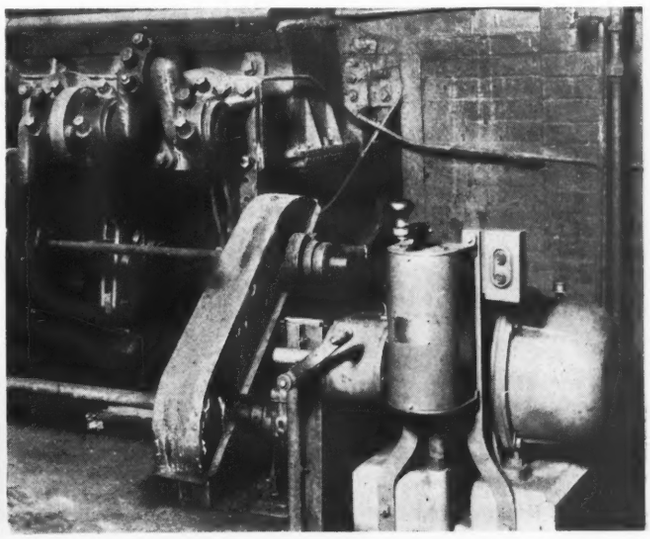


**Fig. 5—A 4-speed gear and a 2-speed squirrel-cage motor give 8 speeds between 1400 and 382 rpm**

# Single-Retort Ram-Feed Stokers

More about automatic coal-burning equipment for industrial boilers. This is the second of a series on construction, installation, and operation of modern stokers

By L N ROWLEY
*Assistant Editor*

RAM-FEED single-retort stokers can be applied to boilers ranging in size from 250 to about 7500 sq ft; in the upper part of this range, twin and triple-retort construction is sometimes used. Although they exhibit more differences as to drive, control, and draft arrangements, than do the more standardized worm-feed units, ram-feed stokers can be applied to nearly all types of boilers without extensive alterations.

As the name implies, coal is fed into the retort by a reciprocating ram or plunger. Distribution within the long retort is effected by auxiliary pushers. The familiar mechanism of underfeed burning takes place; fresh coal is pushed from retort bottom up through the fuel bed, being heated in its passage. Volatiles, driven off, mix with air supplied through the tuyeres, and ignite in passing through the burning coals at the surface. Coal is coked by the time it reaches the surface, where it burns as it is pushed along the grates to the side. Dump grates dispose of ash and clinker.

**Hoppers and Furnace Fronts**—Sheet steel hoppers are common to virtually all ram-feed stokers; some are equipped with agitators, others depend on the slope of the hopper sides to avoid arching of coal. Furnace fronts are usually supplied with the unit. They carry fire doors and necessary operating mechanisms for dumping grates and windbox dampers.

**Ram and Feed Mechanism**—Coal feeds from the hopper into a horizontal tube leading to the retort. Forward motion of the ram moves the coal and shuts off flow from hopper; return stroke uncovers hopper mouth and coal feeds again. In several types, the ram, piston, or plunger, as it is variously known, connects to the driving mechanism by a rod. In others, coal is moved forward by a feeder block fastened to a sliding retort bottom.

Agitation and distribution within the retort may be effected by sliding blocks riding in the base of the retort and actuated from a rod connected to the drive mechanism, or the retort may be equipped with a sliding bottom on which are mounted pusher blocks. Ram and pusher strokes are usually adjustable.

**Retorts and Grates**—Sectional construction is used throughout retorts and grates of stokers of this class, to avoid troubles with distortion under heat and to simplify maintenance. The sections in Fig. 2 show some typical arrangements, including several for retorts with sliding bottoms. End sections are high and plow-shaped to split the coal stream, preventing clinker formation at the bridgewall.

To obtain maximum active grate area, side grates and dump plates are almost always provided with air holes. Air in quantities and at pressures suitable to the fuel-bed conditions is supplied through dampers from the main air chamber. Some units have hollow grate bars and air passes through them from the main to the auxiliary air chambers; this cools grate castings and preheats air (stoker 3, Fig. 2, illustrates this).

Side grates may be either moving or stationary, moving grates being used for higher capacities. They are particularly suitable for burning certain coals, and for use in stokers set in wide furnaces. Methods of producing grate motion vary. In some units, alternate grate bars move laterally, actuated by a rocker arm or cam shaft driven from the drive mechanism (stoker 3, Fig. 2). The side grates of stoker 5, Fig. 2, consist of a series of links, grouped along the long axis of the retort. Two or more rows of links may form the side grates depending on the width of the furnace. An oscillating shaft imparts a wave-like motion to these links; maximum motion is near the retort. Grate motion is usually adjustable from the stoker front.

Smaller sizes of ram-feed stokers

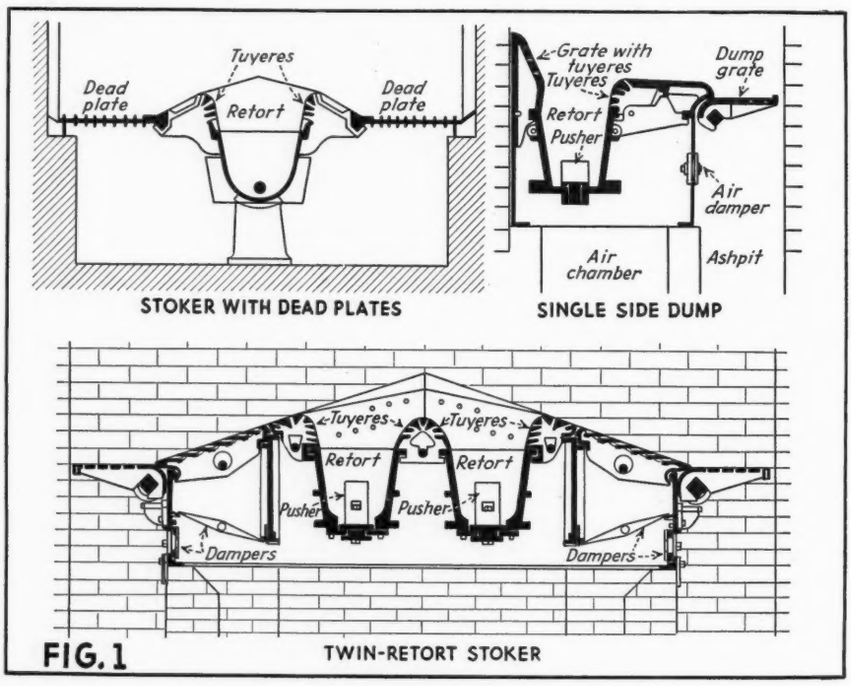
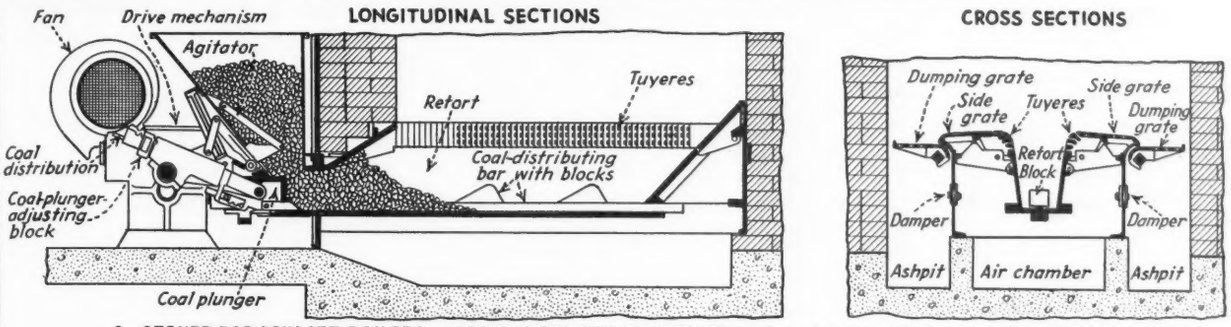
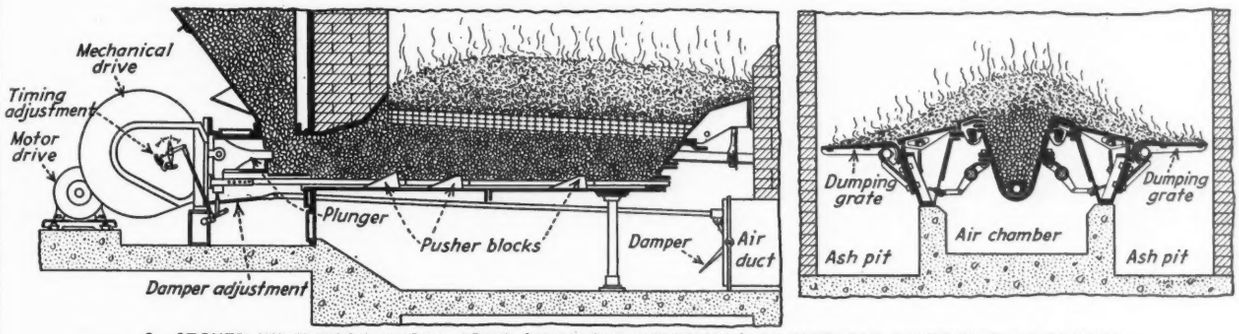



FIG. 1

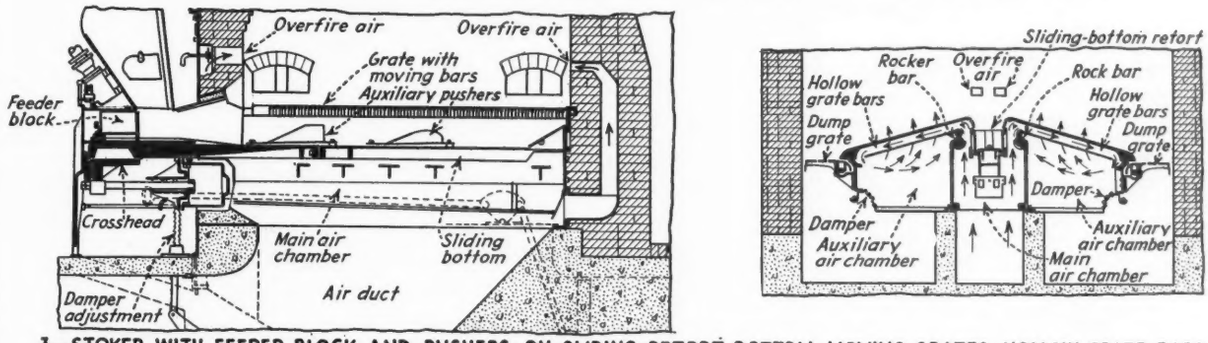
## FIG. 2 TYPICAL SINGLE-RETORT, RAM-FEED STOKERS



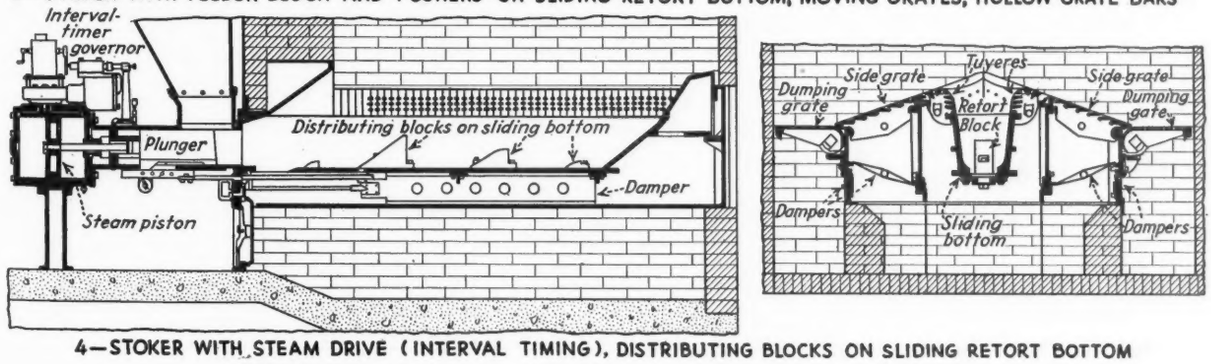

1—STOKER FOR LOW-SET BOILERS—MECHANICAL DRIVE, INTEGRAL FAN, ADJUSTABLE PLUNGER AND BLOCKS



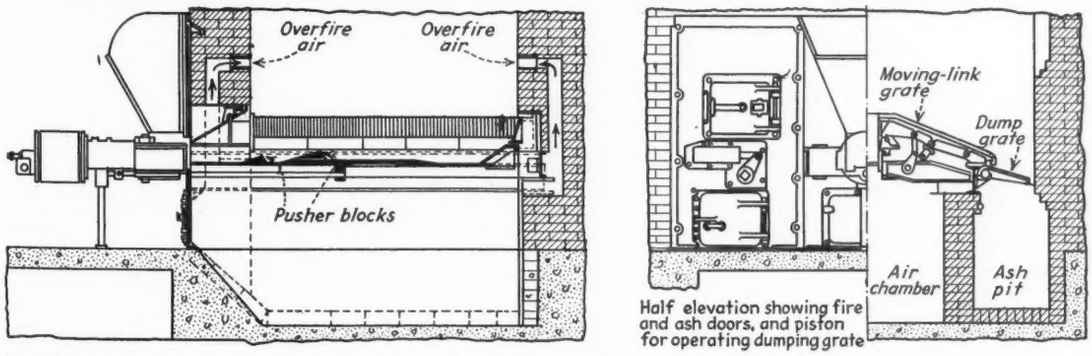

2—STOKER WITH MECHANICAL DRIVE (VARIABLE INTERVAL), ADJUSTABLE DISTRIBUTING BLOCKS




3—STOKER WITH FEEDER BLOCK AND PUSHERS ON SLIDING-RETORT BOTTOM, MOVING GRATES, HOLLOW GRATE BARS




4—STOKER WITH STEAM DRIVE (INTERVAL TIMING), DISTRIBUTING BLOCKS ON SLIDING RETORT BOTTOM




5—STOKER WITH MOVING-LINK GRATES—PARTIAL FRONT ELEVATION SHOWS DOORS, PISTON FOR DUMPING

are equipped with deadplates, or can be arranged for them, Fig. 1. Dump plates are nearly always used, however, to simplify ash removal. They may be hand-dumped or dumped by a steam or hydraulic piston. Sprinkler piping, running the length of the ash pit on either side, quenches glowing ash, after dumping.

A grate and ashpit arrangement designed for narrow furnaces is shown in Fig. 1, employing a single dump. The special up-ended grate at the left side has tuyeres located to supply air to the part of the fire that will build up on the short side.

**Twin- and Triple-Retort Stokers**—To meet heavy loads, two or even three retorts are sometimes combined. Fig. 1 shows a typical twin-retort stoker. In such an arrangement, the feeding rates of the rams can be synchronized or operated at different speeds according to the needs of the fire.

**Fans and Ducts**—A wide variety of fan and duct arrangement is possible with stokers of this class. With mechanical drive, powered by electric motor or steam turbine, the fan can be mounted integrally and driven by the motor or turbine (stoker 1, Fig. 2). Air volume is regulated by an inlet damper or an outlet damper in the duct, if drive is constant speed; by fan speed if variable-speed motor or turbine is employed. Fan and power unit may be remotely located if conditions warrant. Separately-powered fans supply air when stoker is driven from line shafting.

With direct steam drive, the fan must also be separately powered. Location can vary to suit conditions; for compactness a motor- or turbine-driven fan can be located beside or below the drive mechanism. With constant-speed motor drive, volume control would be by damper; with variable-speed motor, engine or turbine, it could be by control of fan speed.

Fan drive for hydraulic stokers depends on location of the hydraulic power unit. When motor and oil pump are integral with stoker, fan may be integral also. It would run at constant speed and dampers would control volume. With a separate fan, any power unit and method of control might be employed. Frequently, hydraulic-pressure pumps and driving motors are mounted on small oil reservoirs and located at a distance from the stoker. Fan is usually mounted on reservoir also, direct-connected to motor.

Some stokers are furnished with a self-contained windbox, but usual arrangement is to build windbox into stoker setting. Duct arrangements thus vary considerably; occasionally several stokers get air supply from a common duct fed by one or more fans.

To create turbulence in the furnace and improve combustion, some units supply air over the fire (stokers 3 and 5, Fig. 2). Control of air distribution from the main air chamber to the side grates and dump plates is important; a glance at the cross sections in Fig. 2 will show how different damper arrangements obtain this result. Damper controls are usually brought out to the stoker front.

**Mechanical Drive** — Constant-speed motors usually power mechanical-drive stokers, but steam engines, steam turbines, or line shafting may do the job. Simplest mechanical transmission is worm and gear for speed reduction; ram travels at constant speed. Coal-feed rate is set by adjusting plunger stroke. Using a variable-speed power unit gives another means of controlling rate of coal feed.

Other mechanical drives control rate of coal feed by varying the interval between strokes, maintaining a constant speed and length of stroke. Gearing effects the necessary speed reduction, timing is usually done with cams. Coal-feed adjustments are made manually, or can be arranged for automatic control.

**Steam Drive**—Where steam of sufficiently high pressure (50-80 lb) is available, steam-piston drive offers economy and flexibility. In the common construction, the steam piston is on the end of the plunger rod. Steam is applied alternately to opposite sides of the piston, producing the desired ram motion. Timing valves govern admission of steam, thus controlling interval between strokes and so rate of coal feed.

**Hydraulic Drive**—In some respects, hydraulic drive resembles steam, in that oil pressure is applied alternately to opposite sides of a piston. In most cases a constant-speed motor and oil pump generate the required pressure; timing devices regulate application to piston, thus controlling feed. Motor and pump may be integral with the stoker assembly or motor, pump, and fan may be mounted on a tank and located where convenient.

**Protective Devices**—Shear pins protect most stokers against jamming of plunger due to foreign materials in the coal. Hydraulic and steam driven units may have relief valves which accomplish the same object.

**Control**—Elements to be controlled are coal feed and air flow; in addition it is advisable to install safety devices to limit boiler pressure or temperature. Means of doing these functions varies with type of drive:

*Mechanical, constant speed*—Coal-feed rate is set by manual adjustment of ram and pusher strokes; air flow by manual adjustment of dampers. Stoker operates on on-off cycle under control of regulator.

*Mechanical, variable speed*—Length of stroke is set manually, speed of stroke depends on speed of drive. With a variable speed motor, control actuates a field rheostat; with steam turbine or engine, control actuates throttle valve. If fan is integral, speed will vary proportionately with feed, as desired; proper fuel-air ratio is set by manual adjustment of dampers. With separate fan, speed control similar to that on feed power unit can be used, or damper openings can be regulated.

*Mechanical, variable interval*—Usual procedure is to operate interval-timing control by a regulating valve or plunger whose position is controlled from a regulating valve working on steam pressure. With integral constant-speed fan, same regulating valve controls damper, and thus air flow. With separate fan, control may be by damper, or regulating valve may throttle steam to driving engine or turbine.

*Steam, variable interval*—In one arrangement, a regulator, actuated by steam pressure, controls a special valve and timing governor, fixing interval between applications of steam to piston. A different scheme employs an automatic valve with eight speeds, driven from the fan, which has a variable-speed drive. Fan speed and air flow is controlled by a regulator working on steam pressure; changes in fan speed control timing of steam admission to cylinder.

*Hydraulic, variable interval*—Here the heart of the control is a timing device regulating admission of oil to the piston. Timing device is usually controlled by a steam-pressure-actuated regulator, as is the fan damper.

**Coal**—Stokers of this type will burn most grades of bituminous, but moderately coking or free-burning coals are preferred. One stoker will take coal up to 4 in. but recommendations are for $1\frac{1}{4}$-in. nut and slack, with not more than 50% slack. Stoker equipment is the same for most coals; differences in volatile content and ash fusion temperature are taken care of in planning the furnace, etc.

*These manufacturers cooperated in furnishing data for this article: Wm Bros Boiler & Mfg Co, Minneapolis; Combustion Engrg Co, Inc, New York; Detroit Stoker Co, Detroit; Flynn & Emrich Co, Baltimore; Perfection Grate & Stoker Co, Springfield, Mass.; Riley Stoker Corp, Worcester, Mass.; Westinghouse Electric & Mfg Co, East Pittsburgh, Pa.*

# Before Lightning Strikes

## That's the time to think about lighting-rod systems. Lead covering fights flue-gas corrosion of conductors and may mean end of a maintenance problem

By RICHARD B EDWARDS
*Lead Industries Association*

WHEN lightning strikes, it's too late to think of maintenance on neglected rod system—too late to do much except get the stack repaired and pay up for damages from falling bricks. Plenty of grief can be saved by the right kind of protection, properly maintained.

Biggest difficulty is likely to be corrosion by flue gas; the conductors, gradually eaten away, part and no longer provide a continuous path to ground. When that happens, the chimney is a perfect target for destructive bolts, as the repaired brick stack in the illustration shows. The new masonry clearly outlines the path of the lightning, and indicates how far the cables had parted from the top circuit cable which was entirely destroyed.

On this stack, corrosion by flue gas caused the down cables to part, leaving them hanging over at a point about 20 ft from the stack top. Lightning struck the top and forced its way down to the upmost point of the down conductors, where the corrosion had ended, from which point it grounded without further damage.

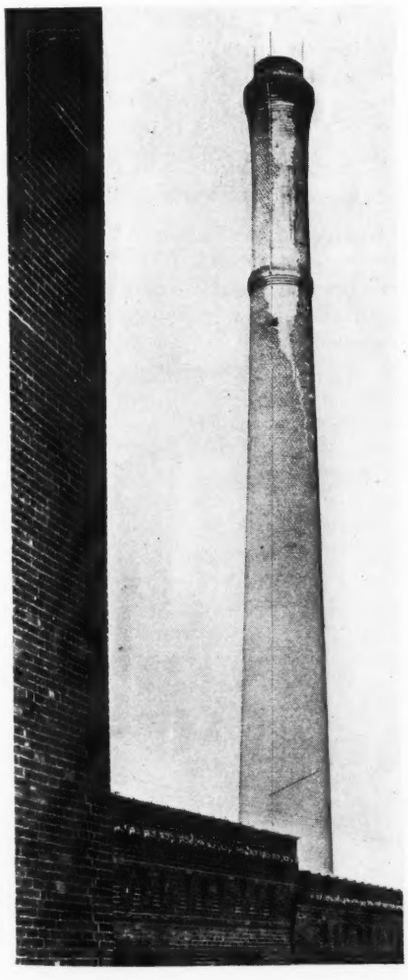
The lightning-rod system on the other stack, where the men are working, had been in place five years when the picture was taken. Flue gas had eaten away the circuit cable and fasteners to such an extent that the fasteners had loosened and the down cable was about to fall. The solid copper air terminals were also corroded, but, being solid instead of woven, had been attacked at a less rapid pace.

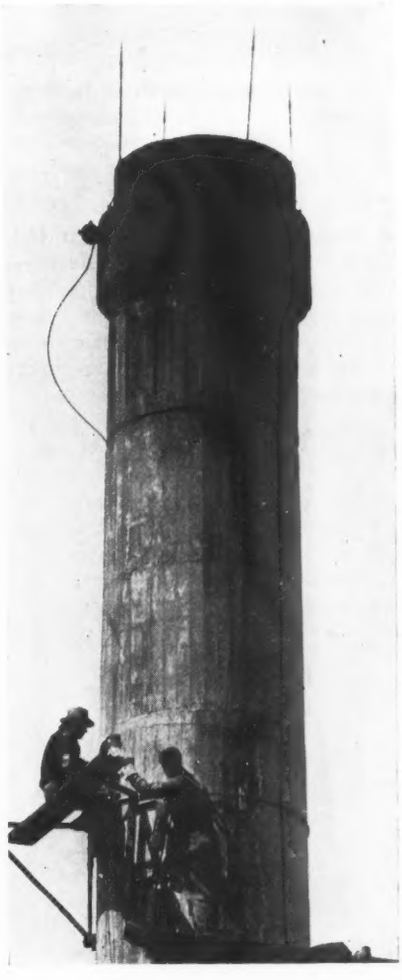
### Durability Needed

Modern lightning-rod systems should combine durability and efficiency if they are to give adequate protection. One way to get both is by means of lead-covered conductors, as lead is extremely resistant to corrosion by flue gas and other agents. It is claimed that lead-covered rods will last as long as the chimney, while the life span of ordinary conductors subject to corrosion may be as short as 3–5 years.

What does a lead-covered system look like? Well, at the top of the stack, solid copper bars, spaced around the chimney head, form air terminals. A woven-copper circuit cable connects the bars to two woven conductors running down the stack, one on each side. They are fastened to the stack at intervals all the way down, and terminate in star-shaped copper grounding bars buried in the earth.

A lead coating not less than 1/16-in. thick covers air terminals, circuit cable, down conductors, and all fittings within 25 ft of the top. To present a continuous lead surface, all connections and fittings are monolithically cast in lead, on the job. Where joints in the lead covering are necessary, they are made by lead "burning" (autogenous welding). Thus there is no possibility of exposing any metal but lead.



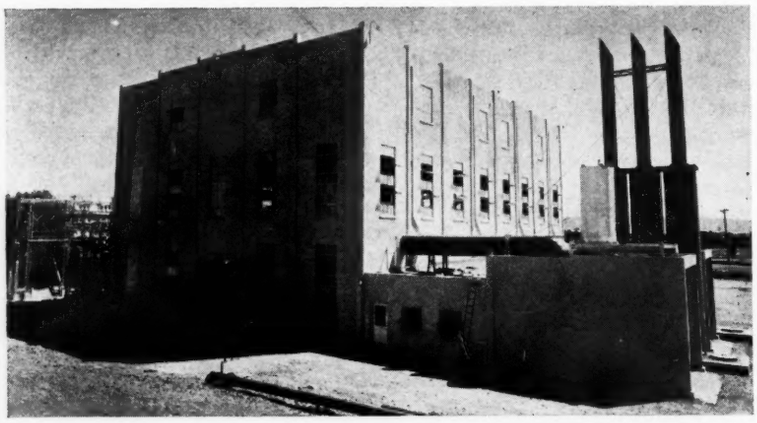


**New masonry on brick stack (left) shows path of lightning when protective system failed. Rods on the stack being repaired (right) have been in place five years; flue gas has eaten away circuit cable and fasteners to such an extent that down cable is ready to fall**

# 7000-hp Diesels Backup Hydro

## Two units, duplicates of Vernon, Calif. machines and largest in the U. S., handle peak loads for Salt River Valley Water Users' Assn, Arizona

By H J LAWSON
*General Superintendent and Chief Engineer*



**There is room for three 7000-hp engines in this steel-frame building with gunite walls and roof**

EQUAL IN SIZE to the diesels at Vernon, California, largest in the United States, a 7000-hp engine now handles peak loads on the irrigation-power system of the Salt River Project, one of the earliest reclamation projects to be undertaken by the Federal Government. Another unit is to be placed in service in September of this year, and space is provided for a third.

When white men moved into the valley during the late 1860's and commenced to build canals and irrigate the fertile land, erratic stream flow made agriculture precarious until the Federal government built the Roosevelt Dam on the Salt River. Power development followed irrigation; released water now flows through hydroelectric plants with a capacity of approximately 115,000 hp.

The Salt River Valley Water Users' Assn, composed of landowners on the Salt River Project, operates the works built by the government and has, with its own financing, built most of the power system as it exists today. There are four dams on Salt River with a power plant at each dam. Heads vary up to 272 ft. There are also four plants on the canal system, utilizing drops in the canals, the heads varying from 19 to 42 ft. All irrigation water from Salt River passes through four plants and some through six, before reaching the irrigated lands.

On Salt River, the two lower dams create regulating reservoirs which fluctuate from practically empty to full each year, making storage for water run through the two upper, high-head plants, and providing power generation at seasons when the demand for irrigation water is at a minimum. Total annual storage capacity on Salt River is 1,900,000 acre ft, of which 1,522,000 are in the Roosevelt Reservoir at the upper end of the developed part of the river. Annual use averages about 700,000 acre ft passing each dam and power plant through a total drop of from 600 to 750 ft.

Power goes to towns and cities in the area, and to private interests for mining, irrigation pumping, manufacturing, cotton ginning, and rural domestic use. To supply this market requires firm power, which means that the hydro system must have standby capacity for emergencies and peak loads. For the past nine years, this has been obtained by interconnection with mining companies operating steam-power plants and by contract with the local utility at Phoenix. When this contract was about to expire, the Association decided to build its own standby plant, the first unit of which is in service.

The interconnected system on which the diesel unit operates consists of: an 80,000-kw water-power system with eight plants, a 12,000-kw water-power-and-steam system, and four steam plants of 30,000 kw, 25,000 kw, 7500 kw, and 7500 kw, respectively. The new diesel plant, the water-power system, the 25,000-kw steam plant and one of the 7500-kw steam plants are 25 cycles; the others are 60 cycles. Systems are tied together by frequency-changer stations. Plants are widely distributed, the distance between the most remote being about 200 miles. At present the 25,000-kw steam plant, owned by a copper mine, is shut down, and only one unit, of 18,000 kw, is operating at the 30,000-kw steam plant.

### Conditions Favored Diesel

When the last addition to the system was being considered, favorable conditions brought about choice of the diesel as an alternative to steam. To carry peak loads it was necessary to operate the steam plant a large part of the time. During much of that time, no steam power was required for eight or ten hours a day, but the plant could not be shut down and started up every day, due to excessive cost. Minimum load on the 18,000-kw turbine was about 4500 kw. Thus, for thousands of hours, fuel was being used to generate power at low economy while water was being bypassed around the power plants, it being necessary to release water for irrigation.

Another drawback was that steam-plant operators insisted on base load being given to the steam plant to avoid load swings of 2000 to 5000 kw coming on the system from mine hoists and other intermittently loaded equipment. Regulation was taken by the water-power plants. Furthermore, to operate this particular steam plant required an operating force of more than 20 men.

On cold standby, six hours are required to put the steam plant in operation; on hot standby, with steam up but the turbine at rest, one to one-and-a-half hours are required.

One 5000-kw diesel-engine-generating unit has been in operation for about a month, handling load variations of the system, with swings up to 4000 kw over 15–30 seconds. With this unit regulating frequency, the water-power plants are given base load at maximum output, with a consequent reduction in kwhr generated by fuel. Increased output by water power costs nothing since irrigation demand exceeds capacity of the wheels from April to October; water is bypassed continuously during those months. With load growth it may soon become economical to install more capacity in some of the hydro plants as peak-load units, even though their use will be limited to six months of the year. The system-load peak in the summer results from a large irrigation pumping load of some 30,000 kw which synchronizes with irrigation demand on the reservoirs. Daily load factor of the system in summer is high, averaging close to 90 per cent.

## Operation

Performance characteristics of the diesel engine are such that variations of load do not affect economy to any substantial degree if load does not go below 50% capacity. With the second unit in (September 1938), the two engines will easily handle all load changes without light load on either unit.

So far, and it is expected these conditions will continue for some time, the diesel unit operates only on peak load, which occurs from 9 am to 4 pm. The plant is shut down in the late afternoon, locked up, and left with only a watchman until 8 am next morning. Within 15 minutes after the operators arrive, the unit is carrying load. It is possible to bring the unit from standstill to full load in less than five minutes. The operating force required for the single unit is five men, and for two units, with 24-hr operation, will not exceed eight men. The 30,000-kw steam plant now operates on base loads which are varied two or three times a day in fairly large blocks. A base load given to this plant usually remains unchanged for many consecutive hours.

## Largest in Recent Years

Unusual interest attaches to the diesel engines as they are by far the largest engines installed in the United States in recent years, and are only equalled in size by the five units in the Vernon plant, which they duplicate (see November *Power,* 1933). Engines are 8-cyl, 24x36-in., 2-cycle, double-acting, solid-injection Hamilton-MAN units, built by Hooven, Owens, Rentschler Division of General Machinery Corp. Woodward governors control frequency. Scavenging air is supplied by a 32,000-cfm Allis-Chalmers blower driven by a 400-hp induction motor (see *Power,* July 1938, for picture).

Diesels drive 6600-v, 25-cycle, 6250-kva General Electric generators with direct-connected exciters and pilot exciters with automatic voltage regulation. Self-cooled Westinghouse transformers step up voltage from 6600 to 45,000 volts, and Kelman oil circuit breakers handle switching. Other equipment includes a Fluor Corporation aerating cooling tower for jacket water, Maxim silencers, and centrifuges for both fuel and lubricating oil.

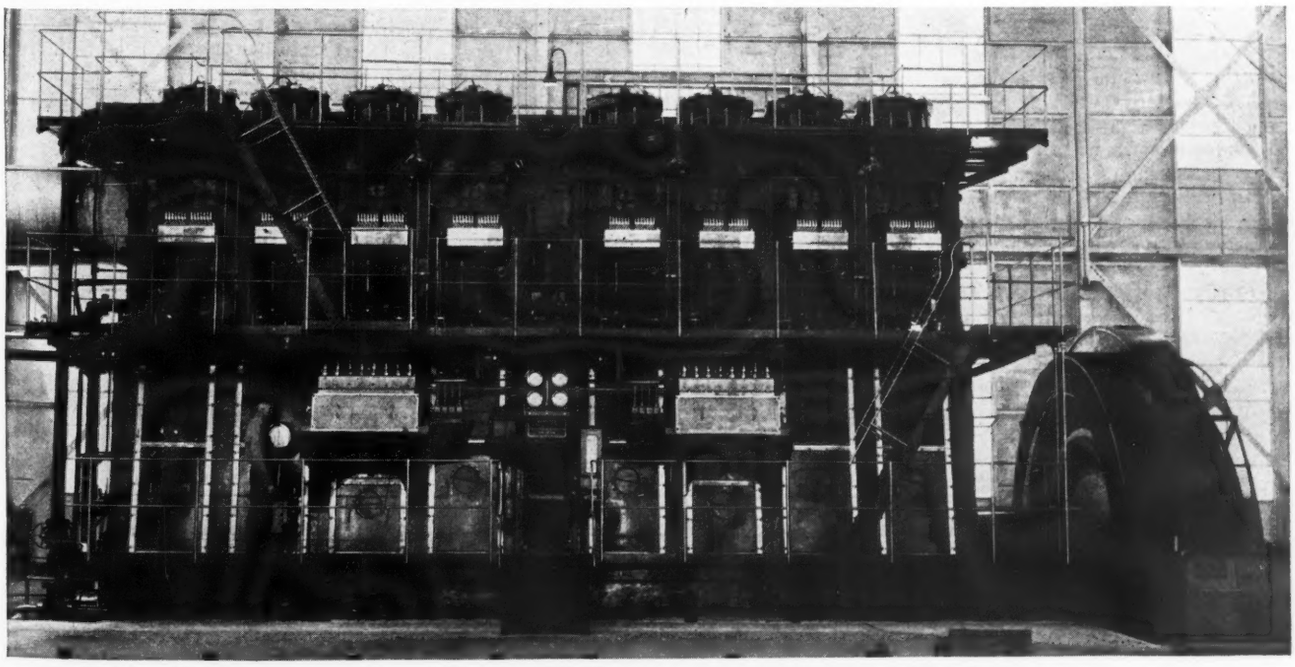
The steel-frame building, designed to house three units, has gunite walls and roof. Asbestos roofing paper cemented to the gunite weatherproofs the roof. Engine and generator foundations are insulated from surrounding ground by cork, 3-in. thick at the bottom and 1-in. thick at the sides.

## Performance

The engine will burn fuel of as low as 18 or 19 deg. Baumé, but it is expected that fuels of a somewhat higher gravity will be used as they are obtainable at reasonable cost and wear on cylinder liners and piston rings will be less with higher grades of fuel. An official test developed 12.93 kwhr net per gal. of fuel oil, or 543 kwhr per bbl at full load.

Cost of the plant complete with two engines, including building, will be about $100 per kw. With fuel oil at present prices it is expected that production cost will be about 4 mills per kwhr depending on load factor, which will be variable.

Investigations leading to the selection of diesels for this standby plant were made by the writer in conjunction with Mr Lin B Orme, president of the Salt River Valley Water Users' Assn. The plant was designed by the engineering forces of the Association with the assistance of Mr H M Peterson, western representative of General Machinery Corp, the engine builders.



**7000 hp concentrated in one 8-cyl, 24x36-in., double-acting, solid-injection unit**

# 25 Ways of Cutting Electric Power Costs

By F A ANNETT
*Associate Editor*

OPPORTUNITIES for reducing power costs beyond the main busbars are just as great as they are in the power house. These include equipment selection, installation and operation and, where power is purchased, rate structures. The fact that purchased-power costs in one plant were reduced 33% and process operations greatly improved with practically the same equipment, indicates that efficient power utilization is just as important as generation.

Efficient utilization must begin with selection of the power-application equipment. More efficient equipment frequently costs no more or may even cost less than that having a lower efficiency. For example, a 15-hp, 570-rpm, squirrel-cage induction motor will cost around $400, where an 1800-rpm gearmotor, geared for 570-rpm output speed, will cost about $350. The gearmotor will have an efficiency equal to or better than the slow-speed motor.

What is frequently more important, the power factor of the gearmotor is 17 points at full load and 30 at half load better than the slow-speed motor. If power is purchased on a rate that has a power-factor clause, the difference in power factor may reduce the power costs to the high-speed motor from 7.5 to 15%. If an 1800-rpm motor with a flat-belt, multiple V-belt or chain drive is used, then cost for motor and drive will be around $225.

### Motor Load

Where the power supply is ac and induction motors are used, for small and medium sizes, the 1800-rpm design is generally preferable because of its high efficiency and better power factor, as indicated in Fig. 1. These curves show full and half-load efficiencies and power factors of 10-hp, squirrel-cage induction motors operating at synchronous speeds between 3600 and 514 rpm. The efficiency of the 1800-rpm motor is 10 points higher than that of the 514-rpm design, but, what is more important, power factor is 20 points higher at full load and 35 at half load.

Motors frequently operate nearer half load than full, so that under normal conditions, the 1800-rpm motor, Fig. 1, would have a power factor around 0.85 and the 514-rpm unit, around 0.50, a difference of 35 points. Many power rates have a clause that increases the power costs 0.5% for each point the load power factor is below 0.85. Then, in this case, increased cost would amount to 17.5%. On the assumption that the motor is 75% loaded and operates 3000 hr per yr on power at 2c per kwhr, increased power expense because of low power factor would be about $70 per year. This is sufficient to pay for a 10-hp, 1800-rpm motor in less than 2 years and will justify consigning the slow-

## 25 Ways to Cut Power Costs

1. Select motor and control equipment suited to the drives and properly install them.
2. Use high-speed induction motors with proper types of speed reducers instead of direct-connected slow-speed motors.
3. Where the system is suited, use modern group drive instead of individual drives with several small motors.
4. Use medium- and large-size synchronous motors instead of induction type where possible.
5. Replace old inefficient equipment with modern motors and control of proper size for the loads.
6. Do not overmotor; if necessary, rearrange motors on their loads to get them more nearly loaded.
7. Correct power factor by keeping motors properly loaded and installing synchronous motors or capacitors.
8. Study rate structures for possibility of obtaining a better rate.
9. Keep down maximum demand by scheduling production operations or by removing temporarily unnecessary loads during peaks.
10. Do not add large blocks of load that would increase the monthly demand, near the end of the month.
11. Meter each department for power used.
12. Keep intelligent records of power consumption and study them for possible ways of reducing consumption and peaks.
13. Make periodic load tests with meters for power consumption and other load conditions of all equipment.
14. Where proper loading of equipment is a factor in power consumption, provide meters so that attendants can maintain the most efficient loads.
15. Where friction loads are likely to increase quickly, install meters so that loading can be observed continuously.
16. Keep shafting and other equipment in proper alignment and do not operate belts too tight.
17. Use anti-friction bearings on line shafts and other equipment.
18. Keep production equipment in good operating condition.
19. Do not waste water or air by extravagent use or through leaks in pipelines, valves or utilizing equipment.
20. Keep pumps and compressors in good condition.
21. Use power lines of ample size and install them properly.
22. Keep power-line insulation in good condition by periodic test and maintenance. An unbelievable amount of power can be lost through poor insulation on a large system.
23. Do not permit motors to run or lighting units to be in use when not needed.
24. Install lighting units so that none need be used when not required and maintain them in good condition.
25. Remember that good maintenance methods always pay large dividends.

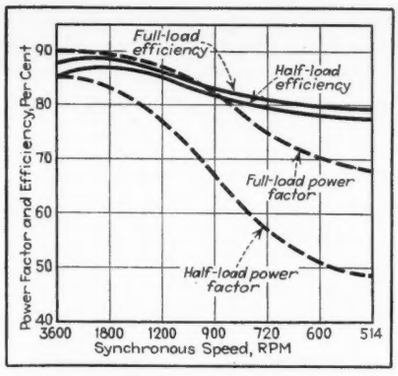



**Fig. 1—Power factor and efficiency of 10-hp squirrel-cage motors at full and one-half load**

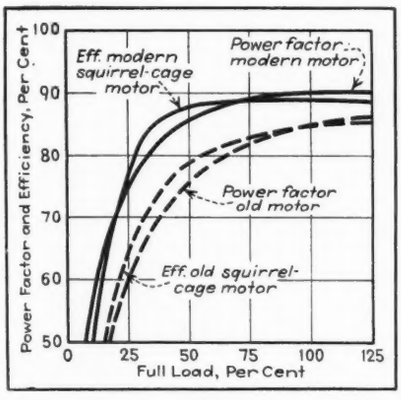



**Fig. 2—Power factor and efficiency of modern 15-hp and old 15-hp, 1800-rpm squirrel-cage motors**

speed motor to the obsolete-junk pile.

Fig. 2 shows the power factor and efficiency of a 15-hp motor. At 100% load, efficiency of a modern motor may be 4 to 5 points and at 50% load, 10 points higher than that of an old one of equal rating. Power factor of the two motors may vary by a similar amount. These two features alone will generally justify replacing old motors with new ones. Frequently, old motors are too large, their speed too slow for their ratings or they are otherwise undesirable for their loads. This makes scrapping the old motors and installing new ones even more desirable. The old veteran for which you have so much respect may be nicking you good and plenty on the cost side of the ledger.

Where power is purchased on a rate having a power-factor clause, one of the most profitable ways to cut power costs is to maintain a high power factor. This is done by proper selection of motors to get them as nearly loaded as possible; installing synchronous motors on medium- and large-capacity drives; and by putting in of capacitors.

### Power-Factor Correction

Whether power is purchased or generated, power-factor correction is always a fertile field for reducing power costs. By correcting the power factor in some industrial plants where power is generated, load was reduced to where the power house could operate with one less unit in service. This reduced power-plant operating expenses sufficiently to pay for the power-factor-correcting-equipment in one year, besides saving the cost of installing several new power cables.

Improperly selected, installed and maintained power wiring can also be a source of large power losses. On a large system where conditions were damp, refurbishing the wiring reduced the load 130 kw. Undersized cables are responsible for large power losses, poor voltage regulation, reduction in motor speed and loss of production.

Keeping line shafting and other equipment in good alignment and belts in correct tension, using proper lubrication and anti-friction bearings, selecting a proper method of speed adjustment where it is required, and many other features in transmitting power from the motor to the driven machine will all help to reduce power losses and cut power costs. In one plant, two 100-kw motor generators were required to supply power to a group of machines and cranes. When these were put in good working condition, one of the motor generators had ample capacity to supply the load.

### Stop Leaks

Large power losses can occur through leaks in water lines and water-using equipment. This also applies to compressed air. Pumps and compressors should be maintained in good condition. A pump operating at 40% efficiency, from all outside indications, may be running just as well as when operating at 80%, but the power bill will show the difference. In one plant, putting the compressed-air system in condition and eliminating wasteful practices permitted shutting down one of two compressors formerly required.

Modern group drives with high-speed shafting in anti-friction bearings supported by hangers mounted on a substantial steel structure have

in many cases reduced power cost by replacing individual drives for small machines.

Intelligent use of meters will point the way to prevent power waste and cut costs. On some types of machines, because of misalignment or other causes, the friction load may increase quite rapidly and unexpectedly. An ammeter or wattmeter on such equipment will immediately call attention to this condition. If load is under the control of an attendant, meters should be provided so that this can be done intelligently.

### Use of Meters

Periodic load tests should be made on all machines not permanently equipped with meters and records kept of these load tests. An increase in load may then be detected and the cause ascertained and corrected. Industrial-plant operations are replete with examples of large power losses caused by faulty equipment that might have been prevented by intelligent metering.

Power should be metered and charged to each department in a plant. Records of this power should be kept and each department head held responsible for an unaccountable increase in consumption. This also applies to water and compressed air if used in considerable quantities. In this way their consumption and power charges can be kept at a minimum.

Much has been said about good illumination, but this should be had without unnecessary waste of power. Install modern efficient lighting units, keep them clean, paint wall of a color favorable to good lighting, arrange the lighting units so that no more than needed at any time will have to be used and if necessary make some one responsible for switching out lighting units not required. Surprising power savings can be made by attention to these details.

Periods when a plant is shut down offer many opportunities for cutting power costs. First, don't forget that water, air and other leaks increase power costs, whether or not the plant is in operation. Unnecessary use of lights, transformer banks not required and left on the line are among the factors that may increase the monthly power bill several percent. Where a large bank of transformers must be kept in service for long periods at light loads, a considerable power saving can be made by installing a small bank to supply the load during these periods. Lightly loaded transformers have low power factor and should be avoided where possible, particularly if power factor is an important item in power cost.

When power is purchased, become familiar with all the rate structures and the elements in these rates that affect power costs. Power companies generally see to it that the customers get the best rate for their loads. However, an understanding of rates and the plant load will frequently show how power costs can be reduced. Power is one of the elements going into the finished product and is worthy of just as careful study in its purchase as any other raw material.

Most power rates comprise a demand and an energy charge. The energy charge may be kept down by means already discussed, but to reduce the demand charge it is necessary to keep down peak loads. Sometimes operations can be staggered to keep down the demand. For example, it may be possible, without interfering with production, to operate a large bake oven or a furnace at night when the load is light. If the furnace takes 500 kw and the demand charge is $1.50 per kw of demand, keeping this load off the day demand would save $750 per month, providing the night peak does not exceed that in the day.

When a heavy load, such as a furnace, is to be added, do not start it near the end of a month, but wait until the first of the next and save the demand charge for one month. Starting a 3000-kw furnace on the 28th of a month cost $3000 in demand charge that could have been saved by waiting two days until the first of the following month.

### Load Control

Frequently, loads such as water pumps and air compressors can be shut down temporarily during periods of heavy loads to keep down the peaks. Such peaks frequently occur only a few times each month. Alarms may be installed to sound when the peak approaches a predetermined amount, when load can be disconnected manually. Equipment is available to keep maximum demand within fixed limits by automatically disconnecting load temporarily until the critical demand period ends and then starting the equipment again.

It is evident from the foregoing that an intelligent understanding of the power load and equipment is essential to reducing power costs. This is intimately interwoven with good maintenance practices, which is always a big dividend payer.

# No Frills

## Atwood & Morrill combined common sense and sound engineering in building a good-looking, efficient 75-kw power plant at their Salem, Mass. factory

ATWOOD & MORRILL didn't set out to show that a small hand-fired power plant could present a fine appearance and do a good job—they started with a need for high-pressure steam for valve testing, and the thought that as long as high-pressure steam had to be available, it would be economical to make a little more and generate power, using exhaust for heating. The resulting plant looks well and performs capably because it fits requirements of this valve factory like a glove, combining low first cost with economical operation.

Steam is generated at 150 lb in a Hodges Boiler Works unit of the Scotch dry-back type, having 1108 sq ft of heating surface. The 90-in. drum is 17 ft long, and holds 108 3-in. tubes, each 18 ft long. The Morrison suspension furnace is 45-in. I D, and 13 ft long, arranged for hand firing of coal. This furnace is adaptable to oil burning, and was selected with that possibility in mind.

A steel stack, 75 ft high and 30 in. diameter, supplies draft; air volume is controlled in accordance with steam pressure by a damper regulator of Atwood & Morrill make, Fig. 1. In addition to changing damper opening to match changes in steam load, a continuous record of steam pressure and damper setting is made on the round chart. In this plant, overfire draft seldom exceeds 0.2 in.; stack draft runs about 0.5 in.

Another regulator, combined with a balanced-lever valve, is mounted beside the damper regulator, and controls flow of steam into heating lines, at reduced pressure. In this way, boiler steam supplements engine exhaust for building heating.

A 14x15-in., 257-rpm Skinner unaflow engine, direct-connected to a 75-kw General Electric generator with V-belt-driven exciter, supplies factory power needs. This heavy-duty side-crank unit has a full-load steam rate of 36.5 lb per kwhr, based on dry steam at 140 lb, and 5-lb backpressure.

A new type of building houses the plant—new at least for power plants in and around Salem. Furnished and erected by the Truscon Steel Co, its steel-framing skeleton carries sheet-steel sidewalls. Walls are about 1-in. thick, with a layer of insulating material between inner and outer steel sheets. A concrete curb raises the lower edge of the sidewalls so that the sheet steel has no contact with the ground.

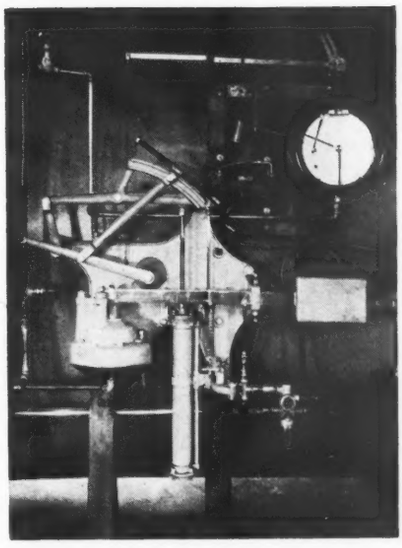


**Fig. 1—This regulator sets damper opening according to steam load; records pressure and damper setting**

Foundations are all concrete. Because the ground is swampy, it was necessary to sink footings 16 ft before sufficiently solid soil was found. In spite of every precaution, there was a slight vibration when the engine was put in operation, but this disappeared completely after two months running.

Trouble-free operation results from the common-sense engineering that went into this small plant. A year's operation has shown a substantial saving over the alternative—purchased power combined with steam generation for valve testing and building heating.

**Fig. 2—Cylinder-end view of 14 x 15-in. heavy-duty side-crank unaflow engine, direct-connected to 75-kw generator**

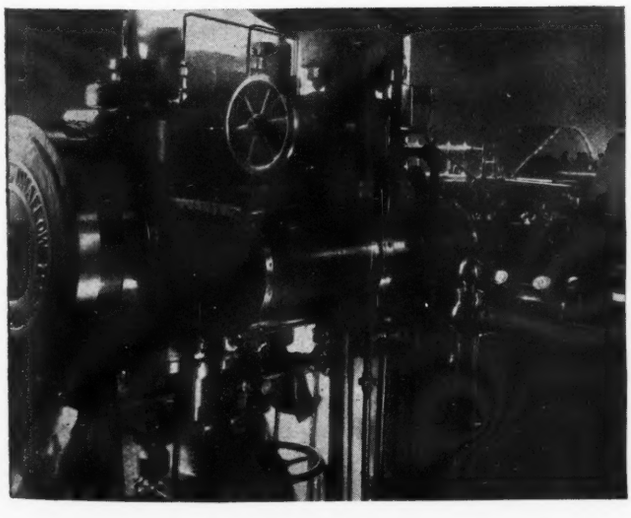
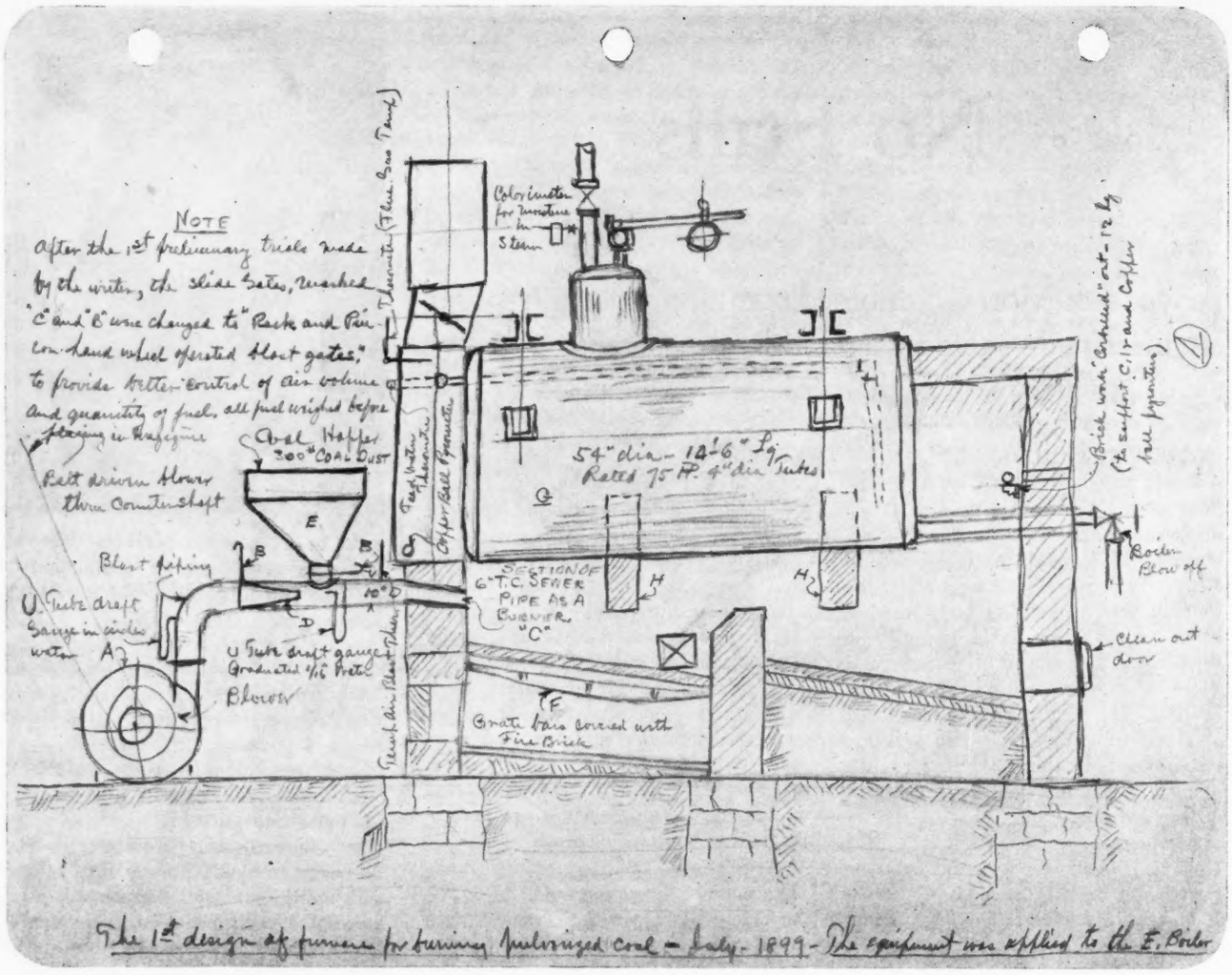


**Fig. 3—The building is steel framed; walls are 1-in. thick with insulation between inner and outer steel plates**


NOTE
after the 1st preliminary trials made by the writer, the slide gates, marked "C" and "C" were changed to "Rack and Pin" hand wheel operated blast gates," to provide better control of air volume and quantity of fuel, all fuel weighed before charging in hoppers
Coal Hopper 200 "COAL DUST
Belt driven blower thru Countershaft
Blast piping
U Tube draft Gauge in inches water
U Tube draft gauge Graduated 1/16 Pretl
Blower
Colorimeter for moisture in Steam
Thermometer (Flue Gas Temp.)
Test Water Thermometer
Upper Ball Pyrometer
54" dia - 14'6" Lg
Rated 75 HP. 4" dia Tubes
SECTION OF 6" T.C. SEWER PIPE AS A BURNER "C"
Grate bars covered with Fire Brick
Brick work "Grouted" with Portland Cement (1 to 2 mixture)
Boiler Blow off
Clean out door

The 1st design of furnace for burning pulverized coal - July - 1899 - The equipment was applied to the E. Boiler

**This pioneer pulverized coal outfit worked too well—blew its makers out of the plant**

# Pioneering Pulverized Coal

## This human document of power engineering in the days at the turn of the century is condensed from the penciled notes of the author, who died recently

By HENRI HUGO du BOURG

AT THE TURN of the century, I was employed by William Kent, well-known mechanical engineer and, at that time, associate editor of *Engineering News*. Mr. Kent was writing his book, "Steam Boiler Economy", and engaged me to verify research data, make drawings, and conduct experiments.

Experiment was not an easy matter in those days. I often talked with Mr. Kent of needed equipment for pulverized-coal experiments. Practically all of the apparatus would have to be designed and built to meet conditions as encountered; hardly anything of the sort could be bought in those days.

At that time, mine owners and even plant operators were figuring ways to get rid of anthracite screenings or culm. If this fuel could be burned in powdered form, it was evident that the method could also be applied to bituminous slack which was also a drug on the market.

Mr. Kent was in contact with Dr. Jacobus (Stevens Institute), Professor White (Brooklyn Polytechnic), Dr. Sibley (Cornell), and many other leading engineers, to gather their ideas as to procedure and apparatus needed to get the desired results. My job was to design, construct, and install the apparatus and make the tests. Mr. Kent had to pay for all of the experimental equipment out of his own pocket, so we bargained and swapped for every piece.

On the outskirts of Roseville and Newark, N. J., was the factory of a

canny Scot named Robertson, who had earned a reputation as a manufacturer of fine hat bodies. He wanted to retire, except for serving selected old customers, so in July, 1899, he turned the steam plant and machine shop over to Mr. Kent. It was an ideal setup for our experimental work with pulverized coal.

The plant was a two-story frame building with basement and attic, and was 55 ft wide and 130 ft long. At one end was the office annex; at the other end was an ell housing the machine shop, and boiler and engine rooms, all of which opened on the factory yard. The building faced on what was then the outer end of Central Ave, Newark.

Water came from three deep wells in ample quantity, but too full of minerals for the health of the boilers. It was customery to shut down for a week twice each year, for factory repairs and scaling boilers. Mr. Robertson's operating men looked after the factory equipment; our province was the power plant. Mr. Kent visited the plant once a week.

### Fan Cost $1.50

After endless combing of junk yards in the Newark area, I assembled a colorful assortment of second-hand equipment for our experiments. For example, a Buffalo Forge fan was picked up in a junk yard, for $1.50. I made it a new pulley shaft, relined and re-babbitted the shaft bearings, burned and scraped off dust and grease, and gave it a coat of black paint. I had little idea how much air was needed to burn pulverized coal, and didn't know whether the blower was large enough for the job.

After much work, the equipment was arranged about as shown in the sketch. Mr. Kent thought the setup was pretty good and told me to go ahead with preliminary testing. At first it was quite a job getting the required "fineness", by which I mean coal fine enough to pass through an ordinary fly screen. I had screened about 1½ tons of bituminous coal by hand before I discovered the uses of a discarded paint mill lying in the factory yard. After a little preliminary fixing, this mill just walked through two more tons in less than an hour. Necessary fineness was obtained by regrinding as often as required.

My next job was to find a safe and easy way to start a fire. I reasoned that it would be safe to start a preliminary fire with oily waste and rags. The existing grate bars were left in the furnace, but covered with two layers of fire brick (with broken joints), plastered with fireclay and ordinary mud. The only other change in the boiler furnace was the building of fire arches ahead of and behind the bridge wall.

Then came the big moment. With all drafts clear, control slides for air blasts and fuel magazines closed, I lit the oily waste and rags and gradually eased open the air and fuel supply. But it wasn't easy to get the coal burning. Four times in succession I tried to start the fire and got nothing much but dense black smoke throughout the plant. Yet each time the setting got warmer and the smoke thinner. Finally I got her going and was able to manipulate air volume and fuel control. For exactly 4½ hours the experimental boiler maintained ample steam supply at 100 lb, with the other boiler banked.

Throughout this run the furnace was quite hot and I noticed that small variations of air volume and fuel supply made a lot of difference in operation. I didn't have a chance to take any readings of temperature, air volume, or fuel, but did learn for a certainty that the method of controlling air and fuel would have to be improved a lot. I wrote Mr. Kent a long report outlining the needed changes and suggesting that they be made as soon as possible.

About this time, a young operating engineer from Newark, by name of Elmer Blackwell, began to take an interest in the work and asked permission to help. Blackwell was an excellent machinist and had the happy faculty of putting his hand on needed equipment or knowing where it could be obtained. Here is a sample of how he worked: I told him of my troubles in manipulating air volume and fuel quantity and indicated what I needed in the way of equipment. Said Blackwell, "You'll find it in the factory yard in the morning", and I did—air blast gates operated by handwheel, shaft, rack, and pinion. The price, he told me, was $2, so no further questions were asked. Neither Mr. Kent nor I ever did find out where those blast gates came from.

### Rigged Draft Gage

The gates didn't exactly fit because they were for 11-in. air-blast piping, but it was not a great chore to make the needed changes and install the gates. Previous tests indicated that air pressure was too high, blowing much of the fuel to the rear of the bridgewall and hanging arch. To be sure, we rigged up a draft gage graduated to read 10-in. of water if necessary.

Another 1½ tons of coal were run through the old paint grinder. The raw material, by the way, was given away by one of the local coal yards. They delivered 5 long tons for a mere $.50 per ton haulage charge. This coal was chiefly bituminous slack, with about 30% anthracite screenings.

Before the next start, I gave the furnace a good warming up with a wood fire, then eased on the air and fuel supply. Smooth operation showed that the blast gates were just the thing for the job. There was no puffing or loss of ignition. For 6½ hours, the experimental boiler supplied the entire steam demand of the plant. Combustion was maintained without difficulty. The flame was clear and incandescent, and you couldn't see a bit of smoke coming from the stack. Everything seemed hunky-dory, so we closed down the plant for the day by shutting off the air and fuel supply.

### Test Run

The morning after he got my report, Mr. Kent arrived for a demonstration and test run. He brought J M Witham of Philadelphia—a retired naval officer who had hung out his shingle as a consulting engineer in Philadelphia. Mr. Witham was especially interested in furnaces for industrial and boiler use. When Messrs Kent and Witham reached the plant I had the boiler running, and Mr. Witham was much interested. He tried his hand at manipulating the control gates under variable conditions, and left saying that he would send a Navy engineer out to look the job over that afternoon.

Mr. Kent and I ran the outfit through the noon hour. I was hopping around from one thing to another, keeping a watchful eye on the air-blast and fuel controls. Mr. Kent was recording temperatures and fuel data when something happened. He had been manipulating the control gates and in some way got a little confused. He had shut off the air but allowed fuel to continue to feed. Then suddenly he remembered that the air control was shut and opened the gate wide. A lot of fuel was lying in the piping to the furnace, and the onrushing air blew it into the incandescent zone.

I can't say exactly what happened next, but I woke up sitting in the factory yard with most of the hair singed from my head, eyes, and hands, and with my blue denims aflame. Naturally I turned at once to see what had become of my boss. What a change! He had arrived on the job togged out in a light, freshly-laundered suit and a brand new straw hat. Now he was stretched out on top of an ash heap with only the brim wrapped around his neck to prove he ever owned a straw hat. His clothing was afire in many places.

It took some time for Mr Kent to come to his senses and realize just what had happened. The boiler setting had been partly destroyed by the

explosion and the boiler lifted from its setting. Steam and water piping was disrupted, the upper part of the boiler house was on fire, and all of the neighborhood was yelling advice. In another 15 or 20 minutes the Newark Fire Department arrived with all its paraphernalia and a bunch of winded horses. The firemen ran hose to a hydrant and put the fire out in jig time. The owner was enjoying a little vacation at a New Jersey beach and so missed the excitement. Fortunately no part of the main building was damaged.

After looking himself over, Mr Kent decided to hire a closed carriage to get home to Montclair, but I rode back to Roseville in less style—on the local express wagon. It took several days for our cuts and blisters to heal. I shall never forget the bright, hot blast of flame and smoke.

Of course there were no laws in Newark in those days requiring steam boiler registration. The insurance companies handled what inspections were made. Mr Kent was well known among the casualty and boiler insurance companies, so it was simply a matter of form to get affidavits from the two of us as to what happened, how it happened, and what caused it. Our chief difficulty was to make the explanation simple enough for the Newark police and fire departments.

The final insurance settlement called for a new steam plant to be designed and constructed under the direction of Mr Kent. The main factory building was to be rearranged and subdivided such a way that the floors could be rented to small concerns who wanted power, steam, and other services. I was hired to supervise the construction under Mr. Kent's direction. When all this work was completed, to the entire satisfaction of Mr. Robertson, we made a few trials and adjustments and found that we had a better plant and a more modern factory.

So we got the plant back, but Mr. Kent was personally out of pocket by the value of most of his testing equipment—thermometers, chemical apparatus, calorimeters, recording pressure gages. These instruments came mainly from France, Germany, and Belgium, and a lot of time and money would have been required to replace them.

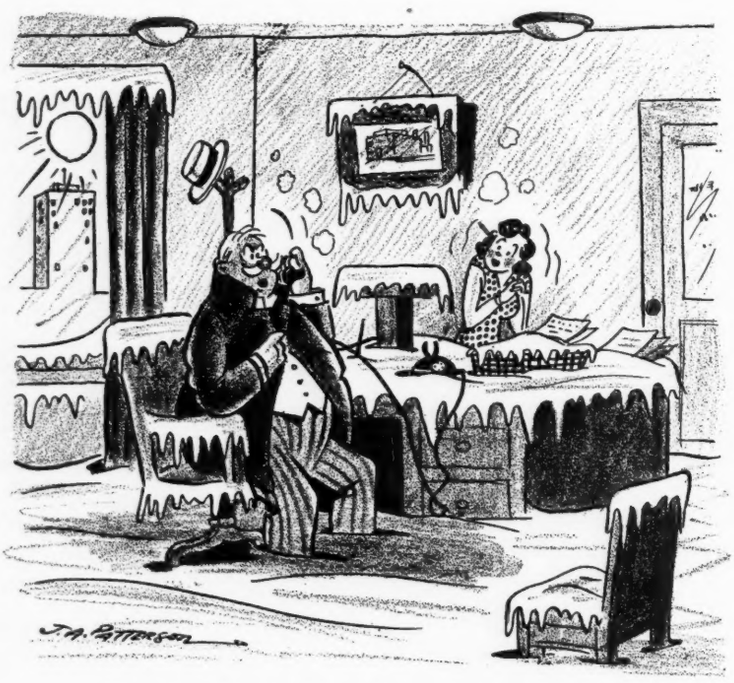
At all times Mr. Robertson gave us every possible assistance. He did not object to our experiments, even after the old plant had "blown up" and the new one was running. He was something of a prophet. He told Mr Kent we had a real find but were in advance of our time. He felt that when the process had been perfected it would be best adapted for continuous operation in large central stations.

Mr Kent and I often talked about our experiments. We agreed that the best mechanical arrangement would be a combination coal crusher, pulverizer, and blower, all in one unit—motor driven, with all essential parts protected. I was convinced that such an outfit could handle low-grade fuels from any part of the country.

We designed three such units. At that point Mr Kent "closed the books" on pulverized-coal experimentation. We looked back on the burns and hard work with the satisfaction that a lot of fundamental progress had been made with simple means.

# Exhaust Lines

When a prospective customer proves to be "from Missouri" on 1500-lb power plants with series boilers and modern steam engines, the Besler brothers, who make them, have an unbeatable answer. They drive one up to the customer's door, in the form of $65,000 worth of steam-powered automobile. As the pressure gage nudges the 1500-lb mark, and the car rolls merrily along, the p-c begins to agree that maybe such plants *are* practical. At least that's the way we felt when riding in the "demonstrator" recently. Biggest thrill, however, was the steam whistle—with 1500-lb behind it, the tooo-oo-oot is hair-raising. A New York traffic cop, who heard it two blocks away, is still wondering how the Queen Mary got so far inland.




"Superintendent, I wish you'd come up here. I think something's gone haywire with th' cooling system"

*General Motor's Kettering has the knack of putting old ideas into stream-lined form—sample: "Research should be an organized effort to find out what you are going to do after you can't keep on doing what you are doing now!"*

"Sunlight piped to all floors" may be as common a slogan some day as the current "Mechanical Refrigeration" signs which swing from modern apartment houses, if the "Heliostat" gets any kind of a start. "It's done with mirrors" is right in this case, since the apparatus, designed by a French company, is a complex arrangement to reflect the sun's rays to all parts of a building. Heart of the device is a moving mirror mounted in a glass cabin on the roof, according to a description in *The Engineer*. Special controls find the sun and hold the mirror focussed on it. Relay reflectors transmit rays through a vertical shaft or any existing courtyard; other mirrors and diffusers bring the sunlight to each floor.

*Real slow-motion movies are being made at Penn State, where Professor Stewart takes pictures of crystalline changes occurring in metals subjected to low temperatures.*

# Oiling—
# Drop by Drop

## Automatic and non-automatic drop-feed oilers—what they are and how they work

By JAMES I CLOWER
*Associate Professor of Machine Design, Virginia Polytechnic Institute*

DROP-FEED OILERS have been developed in a wide variety of designs, for use on plain and anti-friction bearings, chain drives and gears. They are commonly found on steam engines, air and refrigerating compressors, internal-combustion engines, machine tools, etc.

Drop-feed oiling, a decided improvement over hand oiling, is satisfactory under certain operating conditions. Fig. 1 shows a common drop-feed oiler, comprising a small cup or reservoir which supplies oil through an adjustable needle valve to the bearing. A snap lever provides for starting and stopping feed without disturbing rate of feed adjustment. A so-called sight feed permits observing rate of flow. Fig. 2 is similar to Fig. 1, except its body is made of aluminum, making it suitable for severe service where the usual glass cup might break. It has the disadvantage that oil in the cup is not visible at all times.

### Pressure Oilers

A drop-feed oiler designed for air- and refrigerating-compressor cylinders is shown in Fig. 3, suitable for pressure up to 1,000 lb per sq in. By closing valve *B*, the reservoir can be filled without changing feed-regulating valve *C* or without stopping the compressor. Pressure in the oiler is equalized by Tube *D*, which admits full cylinder pressure above the oil. Flow, therefore, is solely due to gravity. These are, however, sometimes referred to as pressure oilers. Special baffle diaphragm *E* and the ball check *F* in the shank divert back pressure from the sight-feed chamber, and insure proper formation of oil drops and their regular and clearly visible discharge. These oilers are generally made of bronze for use on air compressors, and of iron and steel for refrigerating compressors and pumps handling ammonia or other liquids or gases to which ferrous metals offer high corrosive resistance.

### Down-Drop Oiler

The oiler, Fig. 5, is especially designed for small steam-engine and pump cylinders where pressures do not exceed 200 lb per sq in. This type is known as a down-drop oiler, and is installed directly on the steam chest. By closing steam valve *A*, the reservoir can be drained and refilled while the engine is operating, without disturbing the feed-regluating valve *B*. The drain valve is not shown. In operation, steam passes through steam valve *A*, flows up through steam tube *C* and down into the water seal where it is condensed. Condensate then overflows the seal into the reservoir. The oil being lighter than water floats to the top and flows through the drilled passages to the feed-regulating valve, thence down through the sight feed into the cylinder.

Fig. 6 shows a drop-feed oiler for rotary compressors, vacuum pumps, and ammonia-gas boosters. It has a needle valve *V* at the bottom of the

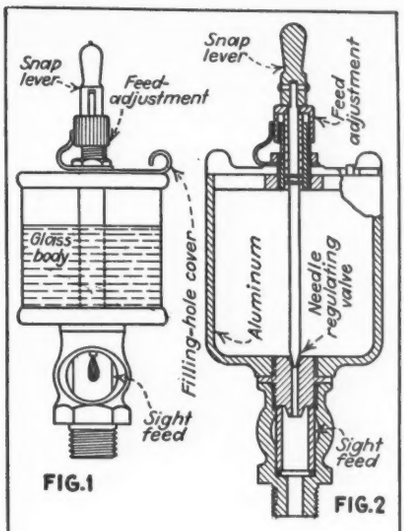


FIG.1 FIG.2

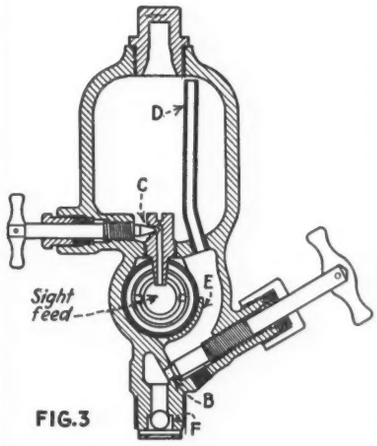


FIG.3

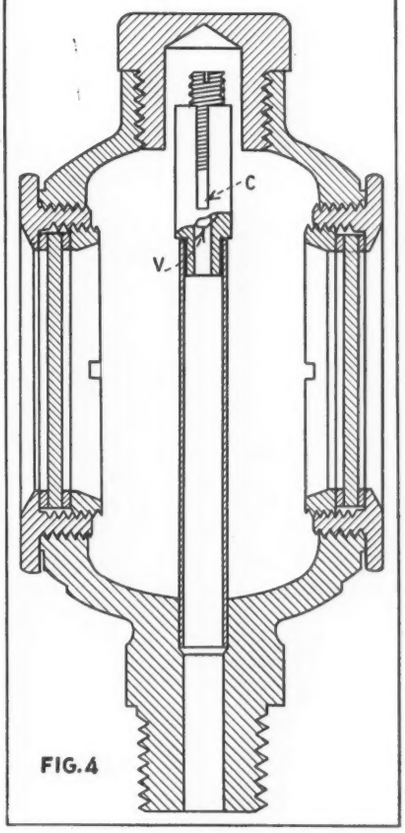


FIG.4

**Fig. 1—Rate of feed depends on oil level and temperature**

**Fig. 2—Drop-feed oiler designed for severe service**

**Fig. 3—Drop-feed lubricator for cylinder pressures up to 1,000 lb**

**Fig. 4—Oiler for engine crankpins and other rotary-motion bearings**

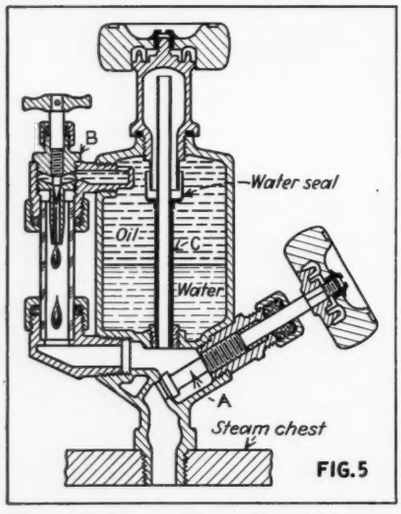



**Fig. 5—Drop-feed oiler designed for small steam-engine and pump cylinders**

oil reservoir with a stem extended through the operating cylinder on top of the reservoir and is opened and closed by pressure from the compressor discharge, exerted under a spring-loaded cup leather piston *P* in the cylinder. The rate of feed is controlled by the knurled feed nut *N* at the top of the stem, which limits the opening of the needle valve. Nut *N* can be used also to open the needle valve by hand in case the compressor is operated without pressure on the discharge side. A minimum of 5 lb pressure is required to operate the oiler satisfactorily. The seal around the needle-valve stem prevents leakage of air from the cylinder into the oil reservoir. This oiler is automatic since it will only operate when the compressor is running.

### Electric Oilers

An electrically operated, automatic drop-feed oiler is available, and is recommended for engines, pumps, and other machinery. The solenoid-operated valve mounted on the steel plunger controls flow of oil automatically. The solenoid valve comprises a coil of wire enclosed in a cast-iron housing which, when energized, lifts the steel plunger off its seat, thus permitting oil to flow out of the reservoir, in much the same way as in Fig. 6. When the current is cut off, the plunger falls by gravity to its seat, thereby cutting off the flow of oil. Designs are obtainable having from one to twelve feeds and four reservoir capacities: namely, one pint, one, two and four quarts. They are available for 110, 220, 440 and 550 volts, 25, 30, 40, 50 and 60 cycle ac, and 110 and 220 volts dc.

The drop-feed oiler, Fig. 7, is actuated by variations in temperature that occur in the oil film surrounding the bearing. These temperature variations are transmitted to the air above the oil in the reservoir. Due to the change in temperature of the air, it expands and contracts, thereby forcing oil down through the feed-regulating valve to the bearing. In order to allow for contraction and expansion of air, this oiler should not be filled more than three-fourths full.

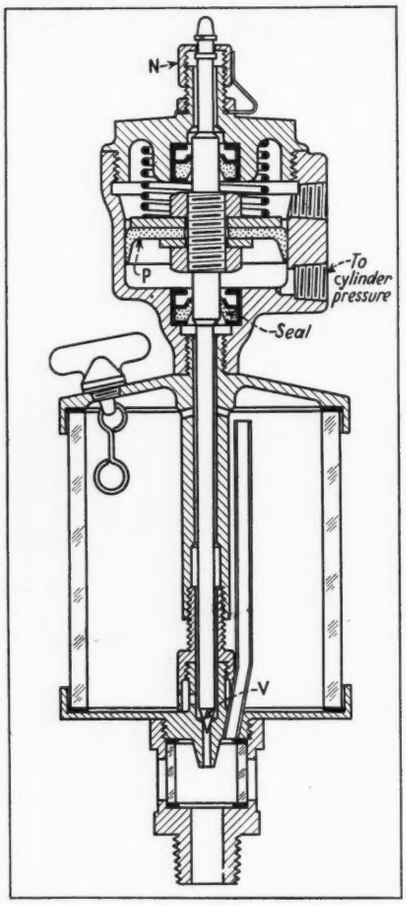



**Fig. 6—Section through air-operated automatic drop-feed oiler**

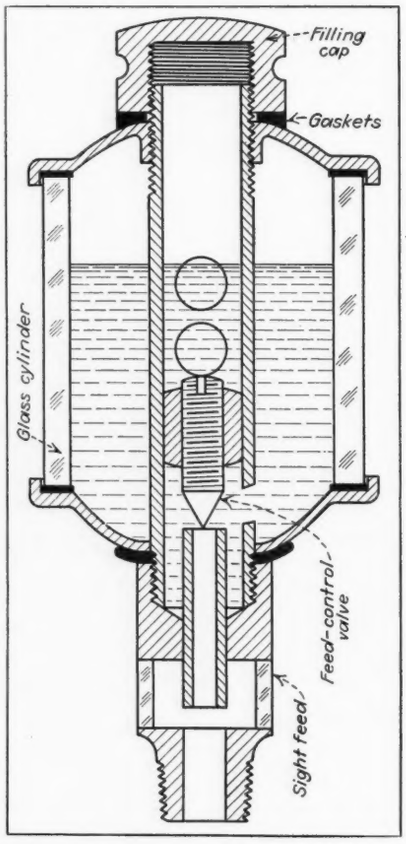



**Fig. 7—Temperature-regulated drop-feed oiler**

Shown in Fig. 8 is a specially designed filter for use in a conventional drop-feed oiler of the type in Figs. 1 and 2. The lines and arrows indicate the direction of oil flow through oiler and filter. The filtering element is composed of closely laid felt which is cleaned when required by filling the oiler with gasoline or kerosene, then agitating it thoroughly and rinsing.

### Crankpin Oilers

Fig. 4 shows an oiler for engine crankpins and other bearings having rotary motion. When the bearing is in motion, the oil is thrown against the feed tube and flows through the outlet channel *C* and down to the bearing. The feed automatically starts and stops when the bearing is started and stopped. The rate of feed is regulated by the adjustable needle valve.

One design of drop-feed oiler maintains a constant level of oil in the reservoir and is used in conjunction with other methods of oiling, such as ring and bath. This oiler operates in the same manner as a simple barometer. Oil feeds only when the level in the bearing reservoir is low enough to break the liquid seal and permit air to enter the oiler.

The author expresses his appreciation for information used in this article to the Lunkenheimer Co, Cincinnati, O.; Wm W Nugent & Co, Chicago, Ill.; Gits Bros Mfg Co, Chicago, Ill.; Swift Lubricator Co, Elmira, N. Y.; Bowen Products Corp, Auburn, N. Y.; and Morrow Mfg Co, Chicago.

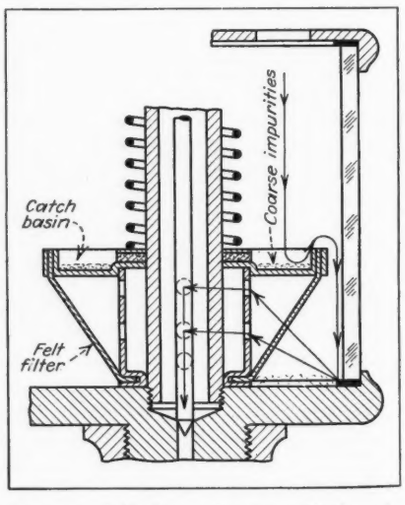



**Fig. 8—Oil filter for installation in conventional drop-feed oiler**

# Dutch Treat

Fig. 1—Eight walking beams (six appearing) act as mechanical power transmission from the one compound steam engine inside to eight outdoor pumps. This achievement of English and Dutch engineers started pumping water in 1849

In Holland, a salt lake plus a pump equals real estate, so good Dutchmen respect good pumps. The Croquis plant (here pictured) did an 84-year stint, starting in 1849. By 1852, with the help of two older steam plants, it had turned the lake of Haarlemmermeer, near Leyden, into taxable real estate. Croquis was retired from active service in 1933 to become a public monument to pumping achievement. Hereafter, the other old plants, now modernized with diesels and electricity, must keep Haarlemmermeer dry.

Engines and pumps in the Watt tradition were supplied by Fox and Son and by Harvey and Co of Cornwall, England; boilers and other equipment by Paul van Vlissingen and Dudok van Heel of Amsterdam.

Housed in the masonry tower is a single, vertical high-pressure steam cylinder, inside of the annular low-pressure cylinder. Hp bore is 7 ft. The ring-shaped lp piston has an outer diameter of 12 ft and an inner of 7 ft, 4 in. The two go up and down together (10-ft stroke), because all rods are attached to the mass of cast iron above. This weight, plus pistons and rods, totals 94 tons.

Steam cylinders are single acting. Steam merely lifts this mass of metal. On the down stroke the weight drags down the inner ends of eight cast-iron walking beams (pivoted radially in the tower walls), while their outer ends lift the eight pump plungers (6-ft bore) through a 10-ft working stroke. This engineering masterpiece made 5 round-trip strokes per minute. Steam pressure was originally 44 lb, later raised to 64 lb and finally eased off to 35 lb. Vacuum (ejector condenser) was 24.5 in.

For the lead on this historic installation, *Power* is indebted to Phil Sprague, president of the Hays Corp, who visited Holland last year. J J J van Panhuys of Schiedam supplied the photos.

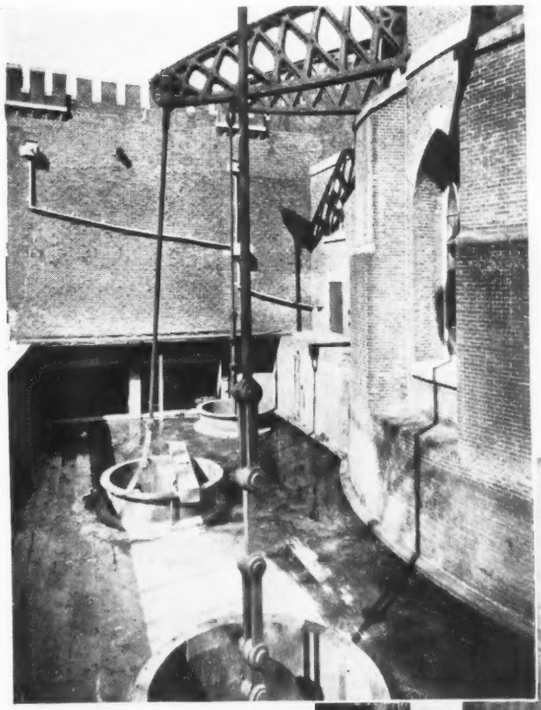


Fig. 3—Near view of three of eight pumps, 6-ft bore, 10-ft stroke, 5 strokes per min.

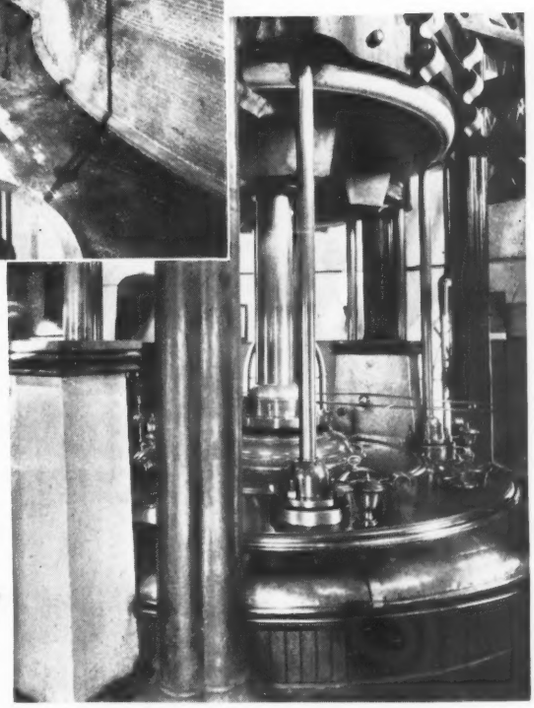


Fig. 2—Big center rod from 7-ft-bore hp piston, and four outer rods from ring-shaped lp piston (12-ft outer diameter) lift 94-ton weight connected to inner ends of beams

★ ★ ★ ★ ★ ★ ★ ★ ★

# Before Purchasing Boiler Equipment

## First they employed a competent consulting engineer and then visited numerous installations of modern equipment

Realizing that they would lose most through an unwise selection of equipment and that the only way to definitely determine the relative merits of boiler equipment was to get out in the Firing Aisle and thoroughly investigate performance characteristics and construction details, Northern Paper Mills executives did the only businesslike thing by visiting numerous recent installations of boiler equipment before purchasing.

This most thorough investigation definitely proved to them that they were making the best possible selection by purchasing Riley "RP" Boilers and Riley Pulverizers.

GREEN BAY
Home of
NORTHERN PAPER MILLS

**THEY FIRST VISITED—**

Here they saw a Riley "RP" unit performing most satisfactorily carrying extreme load variations with excellent steam quality and very steady water level—though guaranteed for a maximum output of 100,000 lbs., load of 120,000 lbs. are easily carried — actual efficiencies are 85.7% against guarantees of 84.1%.

WHEELING STEEL CORPORATION, Portsmouth, Ohio
100,000 lbs./hr. Riley Pulverized Coal "RP" Unit

**THEN VISITED**

Here they saw three 80,000 lbs. per hour pulverized coal fired Riley units that operate so satisfactorily that after being in operation for some time, this company placed repeat order for two 100,000 lbs. per hour units.

**AND THEN**

After this careful investigation they were positive that the Riley "RP" unit was the best equipment which they could purchase and consequently placed their order, through their engineers, Sargent and Lundy. with Riley for two 75,000 lbs. per hour Riley "RP" Boilers and pulverizers.

LARGE CHEMICAL PLANT
3-80,000 lbs./hr. Pulverized Coal Fired Riley Units
2-100,000 lbs./hr. Pulverized Coal Fired Riley Units

TRADE MARK Rx REGISTERED

# RILEY

**STOKER CORPORATION, WORCESTER, MASS.**

Boston New York Philadelphia Pittsburgh Buffalo Cleveland Detroit Tacoma Baltimore Milwaukee Denver
St. Louis Cincinnati Houston Chicago St. Paul Kansas City Los Angeles Atlanta Memphis New Orleans

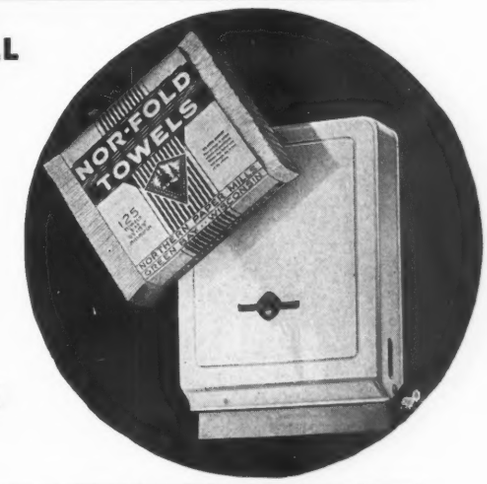
# Northern Paper Mills did the Sensible Thing

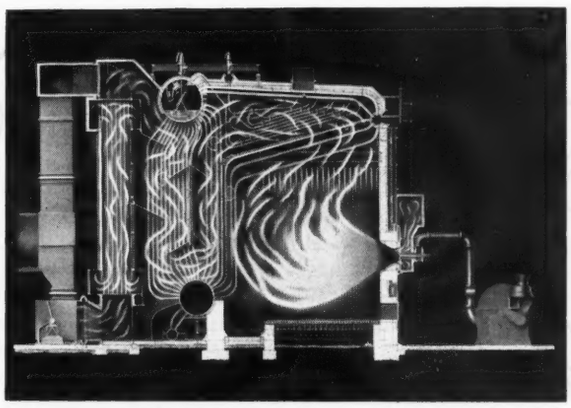
**NORFOLD TOWELS AND NORMEDAL SERVICE ROLL**

Are two of the quality products for industrial use that have made this mill one of the leaders in its field. Hundreds of plants all over the United States use Northern Industrial Paper Products and consistently acknowledge that

*Northern Quality Means Economy*

NORTHERN PAPER MILLS
GREEN BAY, WIS.



TYPICAL DRAWING OF RILEY "RP" UNIT
CENTRAL OHIO LIGHT & POWER CO., Bluffton, Ohio
2-60,000 lbs./hr. Pulverized Coal Fired Riley "RP" Units

**THEN VISITED**

As these units were being erected at the time of their visit they were able to thoroughly investigate construction details and the excellent workmanship always found in Riley units.

W. VIRGINIA PULP & PAPER CO., Williamsburg, Pa.
2-71,500 lbs./hr. Pulverized Coal Fired Riley Units

**THEN VISITED**

Here they saw one 375,000 lbs./hr. pulverized coal fired Riley unit which has been operating satisfactorily for a number of years. A second similar unit is being erected at the present time.

W. VIRGINIA PULP & PAPER CO., Covington, Va.
2-375,000 lbs./hr. Pulverized Coal Fired Riley Units

**THEN VISITED**

At this plant, two 71,500 lbs./hr. Riley units replaced eight straight tube boilers with single retort stokers. These Riley units were guaranteed to produce a maximum steam output of 71,500 lbs./hr., yet have carried continuous loads of over 100,000 lbs. per hour.

COMPLETE STEAM GENERATING UNITS

BOILERS • PULVERIZERS • BURNERS • STOKERS • SUPERHEATERS • AIR HEATERS
ECONOMIZERS • WATER-COOLED FURNACES • STEEL-CLAD INSULATED SETTINGS • FLUE GAS SCRUBBERS

Number 72

# Boiler Safety Rules

**Each of these rules is the direct result of an accident**

## NEVER

NEVER fail to anticipate emergencies. Don't wait until something happens to start thinking.

NEVER start work in a strange plant without tracing every pipeline and learning the location and purpose of every valve. Know your job.

NEVER leave an open blowdown valve unattended when a boiler is under pressure or has a fire in it. Play safe, memory can fail.

NEVER allow sediment to accumulate in gage-glass or water-column connections. A false water level may fool you and make you sorry.

NEVER give verbal orders for important operations or report such operations verbally with no record. Have something to back you up when needed.

NEVER light a fire under a boiler without a double check on the water level. Many boilers have been ruined and many jobs lost this way.

NEVER light a fire under a boiler without checking all valves. Why take a chance?

NEVER open a valve under pressure quickly. The sudden change in pressure, or resulting water hammer, may cause piping failure.

NEVER cut a boiler in on the line unless its pressure is within a few pounds of header pressure. Sudden stressing of a boiler under pressure is dangerous.

NEVER bring a boiler up to pressure without trying the safety valve. A boiler with its safety valve stuck is nearly as safe as playing with dynamite.

NEVER take it for granted that the safety valves are in proper condition. The power plant is no place for guess work.

NEVER increase the setting of a safety valve without authority. Serious accidents have occurred from failure to observe this rule.

NEVER change adjustment of a safety valve more than 10%. Proper operation depends on the proper spring.

NEVER tighten a nut, bolt, or pipe thread under steam or air pressure. Many have died doing this.

NEVER strike any object under steam or air pressure. This is another sure path to the undertaker's.

NEVER allow unauthorized persons to tamper with any steam-plant equipment. If they don't injure themselves, they may cause injury to you.

NEVER allow anyone to enter a boiler without proper protecting signs. Do not remove signs until you have personally checked that everyone is clear.

NEVER allow major repairs to a boiler without authorization. If you don't break a law, you may your neck.

NEVER light a burner without a torch. You can't dodge a furnace blast.

NEVER attempt to light a burner without venting the furnace until clear. Burns are painful.

NEVER fail to report unusual behavior of a boiler or other equipment. It may be a warning of danger.

## ALWAYS

ALWAYS study every conceivable emergency and know exactly what moves to make.

ALWAYS proceed to proper valves or switches rapidly but without confusion in time of emergency. You can think better walking than running.

ALWAYS check water level in the gage glass with the gage cocks at least daily. Also at any other time you doubt the accuracy of the glass indication.

ALWAYS blow out each gage-glass and water-column connection at least once each day. Forming good habits may mean longer life for you.

ALWAYS accompany orders for important operations with a written memorandum. Use a log book to record every important fact or unusual occurrence.

ALWAYS have at least one gage of water before lighting off. The level should be checked by the gage cocks. You will not be fired for being too careful.

ALWAYS be sure blowdown valves are closed and proper vents, water-column valves, and pressure-gage cock open.

ALWAYS use the bypass if one is provided. Crack the valve from its seat slightly and await pressure equalization. Then open it slowly.

ALWAYS watch the steam gage closely and be prepared to cut the boiler in, opening the stop valve only when the pressures are nearly equal.

ALWAYS lift the valve from its seat by the hand lever when the pressure reaches about three-quarters of popping pressure.

ALWAYS raise the valve from its seat with the lifting lever each day the boiler is under pressure. Test by raising to popping pressure once each week.

ALWAYS consult an authorized boiler inspector and accept his recommendations before increasing the safety-valve load.

ALWAYS have the valve fitted with a new spring and re-stamped by the manufacturer for changes over 10%.

ALWAYS play safe on this rule. The one that is going to break does not have a special warning sign.

ALWAYS play safe on this rule. You can't tell which straw might break the camel's back.

ALWAYS keep out loiterers and place plant operation in the hands of proper persons. A boiler room is not a safe place for a club meeting.

ALWAYS put a sign "Workman Inside" on a boiler at the point the man enters. Lock all valves closed that might endanger him if opened accidentally.

ALWAYS consult an authorized boiler inspector before proceeding with boiler repairs.

ALWAYS assume delayed ignition is going to cause a furnace explosion. Use proper ignition methods.

ALWAYS allow draft to clear furnace of gas and dust for several minutes. Change draft conditions slowly.

ALWAYS consult someone in authority. Two heads are better than one.

*H M Spring*


Republication rights reserved

© POWER

# Getting Together on Steam

## District Heating Assn, meeting at Baltimore, considers distribution systems, boiler operation, metering problems and the consumer's viewpoint

OPENING the 29th annual convention of the National District Heating Association, President T E Purcell, Allegheny County Steam Heating Co, Pittsburgh, reported that the Association is on a sound financial basis, a welcome change from deficits of several years past. In his opinion, future reductions in the cost of steam to consumers will depend in large measure on further research into reducing cost of distribution systems. This is one of the projects now being actively followed.

Mr Purcell recommended a continued and more intensive campaign to promote more heating by district steam since everyone in the industry must realize that continued growth can only come from wider utilization of the facilities and service available. All steam companies, he said, should follow the lead set by a few in giving advisory service to their customers on ways and means of reducing bills for steam. In this connection, the Association has available a booklet prepared especially for consumers "Principles of Economical Heating," supplied at a nominal charge by the Association at 1317 Spruce St, Philadelphia, Pa.

In presenting the report of the Educational Committee, Landis Shaw Smith, Rochester, noted improvement in the ability of the companies' engineers to estimate steam consumption of prospective users.

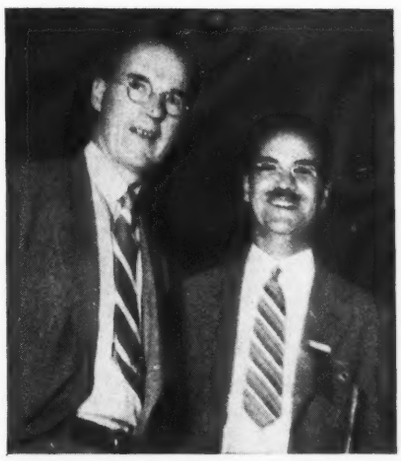
### Distribution

The Distribution Committee, W A Herr, Philadelphia, Chairman, presented a survey of nine construction methods for a 12-in. underground steam main. Engineers from Boston, Detroit, Baltimore and other heating companies submitted complete designs with accompanying cost figures for a typical block-long trench and pipe duct. Designs were those in vogue on their several systems. Wide divergence on many details of practice and unit cost were observed, showing need for further study. Less expensive designs were subject to critical comment in the discussion on grounds of higher maintenance costs. Presentation of these alternate designs affords a convenient comparison for anyone considering underground construction.

### Spare Boilers

A panel discussion on spare boiler capacity, led by A R Mumford of New York, reflected the general practice of being able to carry expected winter steam peak with the largest boiler out of service. The present situation in the various districts, reviewed by representatives of several companies, is satisfactory as far as spare capacity is concerned.

E E Dubry, Detroit, presented a paper written by R G Felger of the same company, describing a condition



**A G Christie, Johns Hopkins, and M D Engle, Boston, seem pleased**

of overheating boiler tubes in a bent-tube boiler on the side away from the fire. This trouble, at the Beacon St plant, was due to carrying too low a drum-water level in an effort to reduce carryover. Raising water-level and installing a perforated baffle in the drum corrected the overheating without producing wet steam.

**J R McCausland, Philadelphia, president of the National District Heating Assn for 1938–9**

A paper on flue-gas scrubbing, reported by T J Finnegan, New York, described experimental spray-washer arrangements at Burling Slip. Effective cinder removal was accomplished but only 10–20% of the sulphur gas was removed by the wash water.

Steam metering is still receiving careful attention by nearly all companies, according to a report presented by W W Stevenson, Pittsburgh, Chairman, Meters and Accessories Committee. Papers at this session discussed testing condensation for the presence of city water, effect of steam-pressure variations on the registration of flowmeters, and the hook-up of condensate meters.

H W Dierman, New York, described nozzle rearrangement in a booster jet of a steam-jet air-conditioning installation where stable operation was obtained by a simple bushing which extended the nozzle length. Application of evaporative condensers to steam-jet systems in limited space was explained by Townsend Tinker, of the Ross Heater & Mfg Co.

Officers for the coming year are J R McCausland, Philadelphia, president; G D Winans, F L Witsell, J M Arthur, vice-presidents; W H Sanford, secretary-treasurer; T E Purcell, L S Phillips and D C Turnbull, new members, Executive Committee.

# Prying Into Fuels, Feedwater

## ASME, at its semi-annual meeting, June 20-23, St. Louis, Mo., centers attention on these two important problems of the power-generation field

WITH more than 700 engineers in attendance, the American Society of Mechanical Engineers held its 1938 semi-annual meeting, June 20-23, Hotel Statler, St. Louis, Mo. The program included three full days of technical sessions, several business meetings, many plant inspection trips and a banquet at which Major James H Doolittle was awarded the Spirit of St. Louis Medal for meritorious service in advancing aeronautics.

### Officers Nominated

The Society nominated the following officers to serve next year: president, A G Christie, consulting engineer and professor of mechanical engineering at Johns Hopkins; vice-presidents to serve for two years, W Lyle Dudley, Westwind Blower Co, Seattle, Wash., James W Parker, vice-president and chief engineer of The Detroit Edison Co, and Alfred Iddles, engineer with Babcock & Wilcox Co; vice-president to serve one year, H H Snelling, senior member of Snelling & Hendricks, patent attorneys, Washington, D. C.

For managers to serve three years, Clarke Freeman, vice-president in charge of fire-prevention engineering and underwriting, Manufacturers Mutual Fire Insurance Co, Providence, R. I.; Dean Willis R Woolrich, University of Texas engineering school; and William H Winterrowd, vice-president, Franklin Railway Supply Co, Chicago. William A Shoudy, consulting engineer of New York, was named vice-president to Dec 1938, to fill the vacancy caused by death of Dean Bennett M Brigman, Speed Scientific School, University of Louisville.

H E Bumgardner, Detroit Edison, presented a paper, "Smoke Density Measurements", at the first session on fuels. The author explained the new instrument, which differs from the ordinary internal-absorption device in that calibrated sleeves shorten thickness of the smoke stream in breeching or stack. Light source and light-sensitive cell, which are protected from dust by lenses, are installed where pressure within duct is slightly below atmospheric, and lenses are kept clean by infiltration through openings in the sleeves. Present installation at Detroit Edison consists of indicator and signal light, both of which respond to current change in the light-sensitive cell.

In discussing the paper, W G Christy, dept of smoke regulation, Hudson County, N.J., commented that the instrument merely replaces the observer who watches the chimney top, that the device perpetuates an incongruous method of smoke measurement (Ringelmann), and that it requires individual adjustment by experimental methods for each chimney.

"Coal Carbonization and Its Relation to the Smoke Problem", by M D Curran, Radiant Fuel Corp and Coal Carbonizing Co, St. Louis, described the Curran-Knowles process for producing smokeless fuel. This process differs from both beehive and slot-type coke ovens. The oven chamber consists of a horizontal hearth heated by flues on under side. Gas distilled from the coal passes up through the coal. The author said that this gives an easily ignited coke which sustains combustion at low temperatures.

The paper was based on experience obtained from the Radiant Fuel Corp's plant which has been in operation since Dec 1933. It is interesting to note that gas produced from the Curran-Knowles process is of such a nature that it is used as a fuel in adapted automotive engines, to generate power.

### Feedwater

At the session on boiler feedwater, the first of four papers was "Carbonaceous Zeolites—An Advance in Boiler-Feedwater Conditioning", by H L Tiger, Permutit Co. The author described new hydrogen zeolites which retain hardness-removal characteristics of zeolite softeners and at the same time eliminate alkalinity with a corresponding reduction in total solids and $CO_2$ content of steam, and an increase in the sulphate-carbonate ratio. Furthermore, said Mr Tiger, these zeolites remove alkalinity present in any form.

**Fig. 1—Delegation from Milwaukee discusses power requirements of a distillery—left to right: R A Wilson and C E Imhoff, Allis-Chalmers; A W Lindstrom, plant engineer, Premier-Pabst Brewery; S E Tray, Allis-Chalmers**

Several feedwater-conditioning installations have been made with these new zeolites in the past few months, one of which, at Williamsburg Plant of West Virginia Pulp & Paper Co, was described on page 358, July *Power*.

F G Straub and T A Bradbury, University of Illinois, authors of "Boiler-Water Treatment—New Methods for Preventing Embrittlement", explained a new method for testing boiler water to determine whether or not it will cause embrittlement. As a result of tests conducted with this apparatus (see Fig. 2), the authors found that

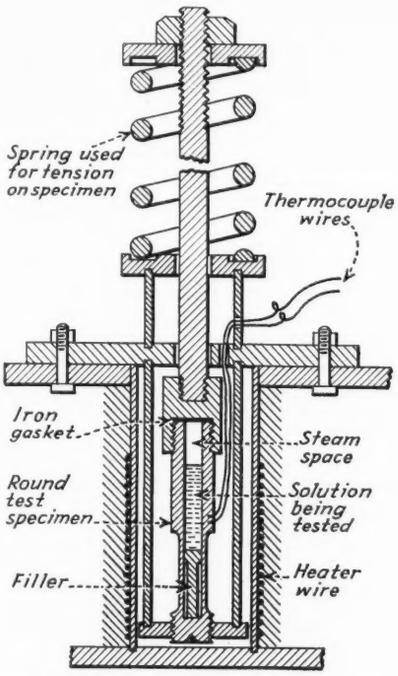



**Fig. 2—Section of embrittlement-testing unit**

for steam pressures up to 250 lb per sq in., embrittlement can be prevented by maintaining sodium-chloride ratio in boiler water greater than 0.6 times total alkalinity, expressed as sodium carbonate, along with a sodium-sulphate content greater than 1.0 times total alkalinity.

For steam pressures between 500 and 1400 lb per sq in., embrittlement is not prevented by maintaining present recommended ASME ratios. The presence of soluble $R_2O_3$ (total iron and aluminum present as oxides) content greater than 0.6 times silica-oxide content of the boiler water appears to prevent embrittlement.

"Boiler Water as It Affects Prime Movers", by S E Tray, Allis-Chalmers Mfg Co, explained factors contributing to presence of solids in steam, and described a method, suitable for field use, for continuously measuring impurities. A meter, which is a recording ammeter connected in series to a conductivity cell through which a sample of condensed steam flows continuously, detects impurities in steam down to 1 ppm or less. In the field, this meter is calibrated against varying quantities of boiler water in distilled water with pH adjusted to conform to that of condensed steam. Adjustment of pH compensates to some extent for dissolved gas and makes the readings relatively accurate.

Mr Tray also explained use of activated carbon to remove organic matter from boiler water and proposed eliminating insoluble silica turbine-blade deposits by feeding iron in the form of a hydrous oxide internally in the boiler. This results in precipitation of silica as a sludge, said the author, and reduction of soluble silica is not only beneficial from the standpoint of turbine operation, but it also eliminates tendency for complex silica deposits to form on heating surfaces.

## Sodium Sulphite

Present use of sodium sulphite for the final step in deoxygenation of water in high-pressure boilers has given rise to considerable speculation as to its freedom from side reactions. Last year at the ASME annual meeting in New York, Prof F G Straub and associates of the University of Illinois reported results of experiments with 0.4% solution of sodium sulphite in steel bombs (see Mid-December, 1937, *Power*, page 809). These tests indicated that rapid auto-oxidation and reduction occurred at temperatures of 540-600 F. A discussion of this paper appeared in April *Power*, page 225, "What Happens to Sodium Sulphite".

Further efforts to discover what really happens to sodium sulphite in operating boilers were reported at this meeting by R M Hitchens, Monsanto Chemical Co, and J W Purssell, Jr, Boston Edison Co, "Behavior of Sodium Sulphite in High-Pressure Steam Boilers." These authors, carrying out experiments on actual boilers operating at 675 and 1400 lb per sq in., found no auto-oxidation or reduction of sodium sulphite. Tests on a third boiler at 1775 lb per sq in. showed slight traces of such reactions. Slowness of sulphite consumption in the three boilers precludes any significant auto-oxidation and reduction of metal.

Of the small amounts of sodium sulphite carried into the steam mechanically, a portion decomposes to sulphate and sulphide. Amounts present, however, are too small to be significant. In view of these findings, the authors concluded that sodium sulphite can be used in high-pressure boilers without harmful effects. A continuous feed to maintain 10 to 20 ppm $Na_2SO_3$ in boiler water was recommended.

**Fig. 3—Left to right at the Smoke Abatement Luncheon: R R Tucker, commissioner of smoke regulation, St. Louis; Harvey N Davis, president of ASME and of Stevens Institute of Technology; and W G Christy, head of smoke regulating dept, Hudson County, N. J.**

Some of the operating engineers, in discussing this paper, said that, now that both sides of the question had been presented, they still didn't know what actually happened to sodium sulphite. Professor Straub admitted that the container in which he conducted his tests (a steel bomb) might have had something to do with the results he obtained, and that more tests would have to be conducted before the question could be definitely settled to his satisfaction.

In conversation after the meeting it was pointed out that the principal difference between the laboratory tests and two field tests was one of solution concentration.

## Smoke Regulation

At a luncheon, June 21, R R Tucker, commissioner of smoke regulation, St. Louis, gave a paper on the history of smoke elimination in that city during the past 71 years. Mr. Tucker said that past history proves that legislation will not abate smoke, even when importation, sale, use, or consumption of certain coals are prohibited. He made a vigorous plea that solution of the problem can only be obtained through wholehearted and constant cooperation of all concerned.

At a session on power and hydroelectricity, H L Harrington, Niagara Hudson Power Corp, and E B Strowger, Niagara Falls Power Co, presented a paper, "Operating Methods and Problems of a Combined Hydro and Steam Electric System". Mr Harrington stated that today a combined hydro and steam electric system requires use of operating methods based on principles of economic loading together with satisfactory service to all customers. Some plan of centralized

power-supply supervision is necessary.

Certain system changes, said Mr Harrington, such as proper interconnection of generating facilities and load areas will be in general required to make such a plan effective and, if input-output data are not available, tests should be made to furnish this information.

John Van Brunt, Combustion Engineering Co, in his paper "Design of High-Capacity Boilers", reviewed development in design leading up to modern high-pressure, high-capacity steam-generating units and showed limitations of earlier types that made them unsuited to high-capacity requirements. H J Kerr, Babcock & Wilcox Co, disagreed to say that each boiler has its own circulation problem —not that some boilers are immune ant others are not.

At the second session on fuels, M H Mawhinney, consulting engineer of Salem, Ohio, spoke on fuels for industrial heating furnaces as distinct from power-producing fuels, reviewed current developments in fuel application and predicted future trends. Hiram L Walton, consulting engineer,

**Fig. 4—Just before a session on fuels: J H Roman (left), consulting engineer, Louisville, and L C Farquhar, asst works mgr, American Steel Foundry, St. Louis**

Detroit, presented "Power-Plant Requirements of a Distillery", in which he described equipment for carrying on distilling processes and the power services required. Mr Walton concluded that there is thermally considerable margin between efficiencies obtained in practice and those possible. Extent to which improvements in future distillery construction and operation will reduce this margin depend on cost of construction and equipment balanced against fuel cost.

"Some Problems Related to the Preparation of Illinois Coals", by L C McCabe, Illinois Geological Survey, discussed washing of coal to remove dust, clay, shale and sulphur to provide greater fuel uniformity, enhanced heat value, less ash and minimum of injurious vapors.

Two papers on flanges were given at the meeting; the first, "Test of Heat-Exchanger Flanges", by D B Rossheim, E H Gebhart and H G Oliver, all of M W Kellogg Co, was an investigation of stresses at various points on several flanges. The second, "Design of Flanged Joints for Valve Bonnets", by J D Mattimore, N O Smith-Pedersen and H C Bell, Walworth Co, explained application of the recent Waters, Rossheim, Wesstrom and Williams' flange-design formulas to a valve-bonnet flange joint, and compared various bonnet-flange designs.

# Engineers' Bookshelf

## Refrigeration

HOUSEHOLD ELECTRIC REFRIGERATION (1st Edition—1938). *By John F Wostrel, Consultant on Industrial Education and John G Praetz, Service Manager, Liquid Carbonic Corp. Published by McGraw-Hill Book Co, 330 West 42nd St, New York, N. Y. 406 pages, 6x9 in., 157 illustrations, 16 tables, cloth binding. Price $4.*

Practical information on the construction, operation and servicing of household electric and gas refrigerators is presented in simple non-technical language. Theory, systems, control devices and service testing are covered with complete reference to typical manufacturers' equipment. It is a valuable book for servicemen and interesting and instructive to anyone seeking information on small domestic units.

## Electric Welding

ELECTRIC WELDING (1st Edition—1938). *By Morgan H Potter, Instructor General Shops, The William Hood Dunwoody Industrial Institute. Published by the American Technical Society, Chicago, Ill. 126 pages, 5¼x8¼ in., illustrated, cloth binding. Price $1.25.*

A practical book that covers the fundamentals of electric arc welding in terms familiar to any welding operator. Starting with a simple description of the various kinds of welding, protective and auxiliary equipment, the discussion covers procedure for welding various materials. A separate chapter deals with power-tube rectifiers.

## Thermodynamics

ELEMENTS OF THERMODYNAMICS (2nd Edition—1938). *By Ernest M Fernald, Professor of Mechanical Engrg at Lafayette College. Published by McGraw-Hill Book Co, 330 West 42nd St, New York, N. Y. 330 pages, 6x9 in., cloth binding. Price $3.50.*

Standard text for classroom use. Special attention is given to vapor-refrigeration cycles, humidity, compressed air and gas cycles and the thermodynamic aspects of flow of liquids and gases.

## Steam and Gas Power

ELEMENTS OF STEAM AND GAS POWER ENGINEERING (4th Edition—1938). *By Andrey A. Potter, Dean of Engineering, Purdue University, and James P Calderwood, Late Professor of Mechanical Engineering, Kansas State College. Published by McGraw-Hill Book Co, 300 West 42nd St, New York, N. Y. 374 pages, 5x8 in., 265 illustrations, 10 tables, cloth binding. Price $2.75.*

The fourth edition of this text brings the contents up to date, and both illustrations and problems have been improved. Intended primarily as a textbook for students, its clear statement of the fundamental principles underlying the construction and operation of steam and gas-power equipment should make it valuable to the operator, also. Covering stationary steam and gas power, and power for transportation, as well, each chapter treats first of principles, then of structural details and auxiliary parts, and concludes with operation and management.

## Instruments

GRAPHIC ROUTES TO GREATER PROFITS (1938)—*By J W Esterline. Published by Esterline-Angus Co, Indianapolis, Ind. 320 pages, 8½x11 in., 439 illustrations, fabricoid cover. Price $3.00.*

Although written by a manufacturing company, this book is in no sense a catalog, but a compilation of the company's experience in the application of recording instruments to industrial problems. It is the outgrowth of thousands of letters received by the company inquiring about the use of graphic instruments for a wide variety of purposes.

The book is divided into 19 chapters and a foreward on the high cost of inefficiency. The first two chapters tell what graphic representation means and

*(Continued on page 106)*

# Current Comment

## What Is Head on a Pump?

IN JUNE *Power* there appeared an article "What is Head on a Pump?", in which an example of finding the total dynamic head of a pump was given. Under the discharge head of the problem, the friction-head loss per 100 ft of pipe according to the table should have been 24 ft, instead of 12.77 ft which was used. The 12.77 ft is the water velocity in a 4-in. pipe, pumping 500 gpm, and not the head loss per 100 ft of pipe. By correcting this error and completing the problem, a total dynamic head of approximately 175 ft would be obtained, and the rest of the problem would change accordingly.

WILLIAM C BERNATZKY
*USCG Patrol Boat HERMES*
*San Pedro, Calif.*

## Steam Engine Economics

IN "The Case for The Engine" (May *Power*) Mr. Vonachen reports surveys showing low power costs. Unfortunately he does not give the fuel cost per 1000 lb of steam. This might explain why one engine running at 50% load, with none of the exhaust used, shows a cost of only 0.552¢ per kwhr, while another running at 70% load with 60% of the exhaust used shows a cost of 1.39¢. The first would indicate a steam cost of less than 5¢ per 1000 lb, while the second would be about 40¢. Comparisons based on such different steam costs mean little unless the steam cost is given.

While, as Mr. Swain states, "true byproduct power is often astonishingly cheap" it is frequently difficult to plan a plant so that power is a true byproduct. Mr. Vonachen's statement of the conditions at the Penn Harris Hotel, upon which he bases his comparison of purchased and generated power, is about as near ideal as could be found. The engine has an annual load factor of 68.5% and runs at or near its most economical load. There is always use for all of the exhaust steam, in spite of the fact that it is used in a heating system or an air-conditioning system, depending on the season. In many cases, there are considerable periods between seasons when neither heating nor air conditioning is required.

Even with Mr. Vonachen's ideal setup, his method of figuring power costs is open to considerable question. He charges only 7.3% of the fuel to power, while with these small engines experience has shown it often runs as high as 20%. His fixed charges are low, as he has used a 20-year life and made no provision for insurance and taxes. However, if 20% of the fuel costs, and fixed charges at 15% are used, the annual engine costs are only $795 or 0.615¢ per kwhr, as against $2274 or 1.76¢ per kwhr for purchased power, which proves the cheapness of true byproduct power.

Now assume that only 60% of the available exhaust steam produced during the year could be utilized, which often might be the case in such a system. Then the engine must be charged, not only with the 20% not available in the exhaust steam, but also with 40% of the available exhaust steam. This is equivalent to 52% of the total fuel cost. The annual engine power cost then becomes:

| | |
|---|---|
| Fixed charges, 15% of $978.00 (includes interest, depreciation, taxes & ins.) | $146.70 |
| Maintenance | 19.56 |
| Steam charged to power, 1.112×7500×0.52×0.37 | 1604.62 |
| Lubrication | 11.90 |
| Total | $1782.78 |

Or 1.39¢ per kwhr.

This still shows a saving of $492.09 per year, or 35.3% on the investment above fixed charges. It also shows the rapid increase in the cost of power as the percentage of true byproduct power decreases.

I thoroughly agree with Mr. Swain that it is advisable to design a plant *out of balance*, at least to the extent that the minimum steam demand will supply the power requirements, if this can be done without unduly increasing the first cost. In cases where the demand for exhaust steam is small as compared with the power demand, purchased power will often prove to be the cheaper.

The steam engine certainly still has a useful place in power generation and a thorough understanding of the byproduct power made available by use of these small units will increase its importance.

*Hamden, Conn.* W W GAYLORD

## One Wrench Aids the Other

WITH REFERENCE to the letter by J W Rogers under the above title in May *Power*, I am usually opposed to making wrenches longer to obtain more leverage, either with a piece of pipe or by any other means. All readers of *Power* doubtless have observed that wrenches for small nuts are invariably short; for medium nuts they are medium in length; and for large nuts, they are long. The manufacturers have a system in making wrench lengths that takes into consideration thread pitch, cross-sectional area of the bolt at bottom of threads, and strength of the average man who does the tightening.

When you make a wrench twice as long, you increase the tension on the bolt to twice the amount, the pull on the wrench being the same. By increasing wrench lengths, I have actually stretched bolts until they broke in two, or I stopped turning as soon as I felt the bolt begin to stretch. This is poor practice, and I do not increase wrench's lengths any more because I realize that the elastic limit of a bolt should never be reached.

If you feel like making a wrench longer for unscrewing a nut, that is all right, but don't make a wrench longer for tightening the nut on any bolt.

*Newark, N. J.* J H SQUIRES

# Power Lines

## Advisory Committee Named for Power Show

Irving E Moultrop, formerly chief engineer of the Boston Edison Co, was reelected chairman of the Advisory Committee of the 13th National Exposition of Power and Mechanical Engineering at a meeting of the Committee held in New York recently. Plans for the Exposition, which will be held at Grand Central Palace in New York, December 5 to 10, were discussed, and as a result several new features will be added to this year's show.

John H Lawrence of Interborough Rapid Transit Company was elected vice-chairman of the Committee. Other members include Homer Addams, past president, ASHVE; Fred Felderman, past national president, NAPE; C F Hirshfeld, chief, Research Dept, Detroit Edison Co; David Moffatt Myers, consulting engineer; Arthur L Rice, editorial director, *Power Plant Engineering;* P W Swain, editor, *Power;* and Charles F Roth, manager of the Exposition.

The large number of exhibitors who already have reserved space on the three floors of Grand Central Palace indicates that early preparations are being made to make the 13th Power Show eclipse the outstanding exhibit successes of past years. An attendance of over 40,000 registered visitors from all over the United States and from foreign countries is expected.

According to Charles F Roth, president of the International Exposition Co, many "charter" exhibitors—those who showed products at the first Power Show in 1922 and who have exhibited in every subsequent presentation—will exhibit again this year. Many entirely new

products will be put on display, and other exhibits will demonstrate the latest improvements in standard equipment. As a result, the Exposition will represent the latest and most complete assembly of power and mechanical equipment to be seen anywhere during the year.

## Cincinnati Gas & Electric Wins Coffin Award

The Cincinnati Gas and Electric Company was the winner of the Charles A Coffin Medal for 1937 for its outstanding contributions to the public. The company's efforts in successfully maintaining uninterrupted service during the Ohio river flood crisis and in promoting use of electricity by effecting one of the lowest domestic rate schedules in the United States were cited when the presentation was made by H P Liversidge at the annual meeting of the Edison Electric Institute, Atlantic City, N. J., June 8.

Accompanying the gold medal was a check for $1000 to be given to the employees' welfare fund. The Charles A Coffin Foundation, established by the General Electric Co. in 1922 in honor of its founder and first president, each year presents a gold medal and $1000 to the company which during that year has made a distinguished contribution to the development of electric light and power for the convenience of the public and the benefit of the industry.

The committee, in determining the award to the Cincinnati Gas and Electric Co, was particularly impressed with the company's action in rate reduction. It now has one of the lowest rate schedules in the United States. Its efficient handling of the 1937 flood crisis when the Ohio river was above flood stage for 18 days, during which time the company was able to maintain electric service to communication systems, newspapers, hospitals, food-processing plants, doctors' offices, hotels, and water-pumping stations without interruption, was an outstanding example of public service, in the opinion of the committee.

## OBITUARIES

ARTHUR W CHESTERTON, 80, founder of A W Chesterton Co, Boston, Mass., manufacturers of mechanical packings and steam specialties, died June 22. Mr Chesterton, born in England in 1858, was one of the pioneers in mechanical-packing field. He was the first to introduce a compressed asbestos sheet packing in the U. S., and in 1915 he introduced one of the first high-pressure gage glasses. Mr Chesterton is also said to be the first to use the red reflecting strip in gage glasses to make the water line visible.

ARTHUR P VAN SHAICK, 55, vice-president of American Chain & Cable, Inc, died June 7. His early business experience was with Pittsburgh Plate Glass and Lackawanna Steel. In 1919 he joined American Chain as manager of sales, and 3 years ago was elected vice-president in charge of sales of all divisions.

ALBERT B CARMICHAEL, 70, for over 40 years president of Stillman-Carmichael Co, manufacturers of boiler-regulating equipment, Boston, Mass., died at his home in that city, June 7.

GEORGE E EMMONS, 80, formerly manager of the Schenectady Works of General Electric Co and later vice-president in charge of manufacturing for the company, died in Pasadena, Cal., July 1.

ALGY R BATTEN, 47, assistant general manager of Iowa Public Service Co at Sioux City, Iowa since 1932, died June 16. He came to Sioux City from Fort Dodge, Iowa, where he was chief engineer for the same company.

JOSEPH EDWARD MCKENNA, 69, for many years associated with Jenkins Bros, valve manufacturers, died June 28 at his home in South Ozone Park, Long Island, N. Y. Mr McKenna, a veteran minstrel man, was well known for his black-face comedy acts at engineering conventions and meetings. In 1925 he joined Jenkins Bros and took charge of arrangements for his appearances at conventions and entertainments throughout the U. S.

## Meetings

**American Institute of Electrical Engineers** —*Pacific Coast Convention, Aug 9–12, Multnomah Hotel, Portland, Ore. John Bankus, secretary, 818 W Burnside St, Portland.*

**American Society of Mechanical Engineers** —*Fall meeting, Oct 7–9, Biltmore Hotel, Providence, R. I. C E Davies, secretary, 29 W 39th St, New York, N. Y.*

**American Welding Society**—*Annual meeting (in conjunction with Metals Congress Exposition), October 17–21, Detroit, Mich. M M Kelly, secretary, 33 W 39th St, New York, N. Y.*

**National Association of Power Engineers** —*56th Annual Convention and Power Show, Aug 29 to Sept 2, Civic Auditorium, Grand Rapids, Mich. Fred W Raven, 176 West Adams St, Chicago, Ill.*

**Technical Association of the Pulp and Paper Industry**—*1938 Fall Meeting, Sept 8–10, Northland Hotel, Green Bay, Wis. R G MacDonald, secretary, 122 E 42nd St, New York, N. Y.*

**Universal Craftsmen Council of Engineers** —*35th International Convention and Great Lakes Power Show & Mechanical Exposition, Aug 2–6, Hotel Hollenden, Cleveland, Ohio. E H Smith, chairman 6523 Euclid Ave, Cleveland.*

## PERSONALS

DR JOHN C PARKER, vice-president, Consolidated Edison Co of N. Y., Inc, has been elected president of the American Institute of Electrical Engineers for the year beginning Aug 1, 1938.

J G SKIRM, formerly assistant manager of the Fibre Conduit Div of Brown Co, has been appointed manager of that division, to succeed Edmund Burke, recently retired. Mr. Skirm will have headquarters at the company's general offices, 420 Lexington Ave, New York, N. Y.

JOHN A MILNES, Manchester, N. H., was recently elected president of the New England Assn of Power Engineers at its annual meeting in Springfield, Mass. Mr. Milnes was formerly vice-president of the organization.

THEODORE MAYNZ has opened offices at 270 Madison Ave, New York, N. Y., for consultation on steam power-plant problems. Mr. Maynz is resuming consulting practice he maintained for nine years in Cleveland, Ohio.

JAMES LANG retired recently from his position as chief engineer of the Sherman Creek Station of the Consolidated Edison Co of N. Y., Inc, after 36 years of service.

WILLIAM CULBERT, chief smoke inspector, Nashville, Tenn., was reelected president of the Smoke Prevention Assn at its recent annual meeting in Nashville. Other officers elected were: first vice-president, Stanley C Higgins, secretary of New River Coal Operators Assn, Mt. Hope, W. Va.; 2nd vice president, H V Carlson, New York Central RR, Chicago, Ill; and secretary-treasurer, F A Chambers, chief smoke inspector of Chicago, Ill.

C V HAYNES and James K Peacock, Hoffmann Specialty Co, Waterbury Conn., have been elected life members of the American Society of Heating & Ventilating Engineers. Both have been members for many years, Mr. Haynes serving as president of the Society in 1934.

WILLIAM ARTHUR has been appointed Philadelphia district office manager of Allis-Chalmers Mfg Co to succeed the late J E Wray. Mr Arthur, who is widely known for his engineering contributions to electric traction, since 1931 has been the company's special representative in the East. For six years prior to his connection with Allis-Chalmers, he was manager of the traction department and assistant to the vice-president of the American Brown Boveri Electric Corp until its electrical activities were absorbed by Allis-Chalmers.

## BUSINESS ITEMS

BIGELOW-LIPTAK CORP, Detroit, Mich., has appointed D H Skeen & Co, 1 N LaSalle St, Chicago, Ill., as representative in the Chicago territory.

BURGESS BATTERY Co has moved its home offices from 111 W Monroe St to 500 W Huron St, Chicago, Ill.

FOXBORO Co, Foxboro, Mass., has moved its Dallas, Tex. office to 1710 N Akard St, in order to have more space for stocking equipment.

L J WING MFG Co, New York, N. Y., has appointed T F Schenke, 704 Prospect Fourth Bldg, Cleveland, Ohio, as its representative for heating and ventilating equipment.

LEAVITT MACHINE Co, Orange, Mass., has appointed Canadian Fairbanks-Morse Co, Montreal, distributors for valve-reseating machines and automatic separators for compressed-air lines in Canada.

MARLEY Co, Kansas City, Kan., water-cooling-equipment manufacturers, opened a branch sales office in Atlanta, Ga., re-

cently. T A Robin is in charge of the new office in the Walton Bldg.

FUEL ENGINEERING CO OF N. Y. has moved its offices and fuel-testing laboratories to 215 4th Ave, New York, N. Y.

UNITED CONVEYOR CORP of Canada, Ltd. has appointed Taylor Engrg & Const Co, Ltd, Toronto, as exclusive agents for Ontario.

HARVEY B MANN, long identified with DeLaval and Cochrane sales in the Pittsburgh district, has established the Mann Engrg Co, 429 Penn Ave, Pittsburgh, to represent Fischer & Porter Co, Fuller Co, Richardson Scale Co, Springfield Boiler Co, Sterling Engine Co, and Bin Dicator Co.

MURPHY DIESEL Co, Ltd, has appointed W C Morgan district sales manager in the Southwest territory, with headquarters at Tulsa, Okla.

CULMINATING a reorganization plant began more than two years ago, Pomona Pump Co, Pomona, Cal., has announced a number of changes in its executive personnel. D C McKenna becomes vice-president and secretary-treasurer. Jules H Coffey was named vice-president in charge of sales. C C Cook, formerly in charge of the St. Louis plant, comes to Pomona as vice-president in charge of manufacturing. Charles L Barrett has been appointed general sales manager. R D Schott chief engineer, Barclay MacKinnon comptroller, and I A Oliver continues as consulting engineer.

SHEFFLER-GROSS Co, Philadelphia, has appointed Specialty Products Co, Boston, Mass., distributors in the New England states for suction and discharge strainers.

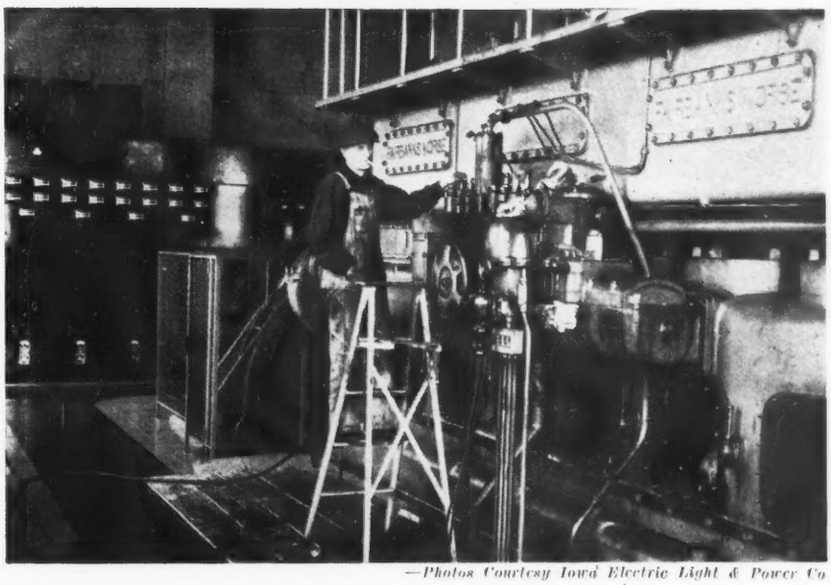
POWER PIPING DIV of Blaw-Knox Co, Pittsburgh, Pa., has opened a southern sales office in the Candler Bldg, Atlanta, Ga., with O'Earl Kearney in charge.

SIMPLEX VALVE & METER Co, Philadelphia, Pa., has appointed C W Baldwin, 230 Congress St, Boston, Mass., representative for New England, and J J Heinrikson, 3689 Jefferson St, for Kansas City, Mo.

GREENE, TWEED & CO, New York, N. Y., elected the following officers at a recent directors' meeting: F J Demarest, president; and H G Russell, treasurer and general manager. J A McKeon remains vice-president and H A Erwood, secretary.

BREUER ELECTRIC MFG Co, Chicago, Ill., has moved into a new 2-story plant and office building covering 20,000 sq ft of floor space, at 5100 N Ravenswood Ave, Chicago.

RAINS METALLIC PACKING Co, Spokane, Wash., has appointed Justo N Lopez as representative at Manila, P. I. R M Makemson has been promoted to field manager for California, with offices at 1st and Brannan, San Francisco. Also, a branch office has been established at Midland, Mich, under management of R P Anthonisen, for Ohio, Michigan, and Pennsylvania.



—Photos Courtesy Iowa Electric Light & Power Co

**DIESEL ENGINEERS AT WORK**

**Station engineer R W Nash directs diesel overhaul at Nevada Station of Iowa Electric Light & Power Co. Lower photo shows Engineer Nash starting to work on fuel-oil injection pump. Above, four men begin general overhaul of same engine**

SULLIVAN MACHINERY Co has moved its general offices from 307 N Michigan Ave., Chicago, to Michigan City, Ind. Chicago sales office will remain at the Chicago address.

REPUBLIC FLOW METERS Co, CHICAGO, Ill., has appointed Frye Engineering Co, 209 Farnsworth Bldg., Memphis, Tenn., as representative for surrounding Kentucky, Tennessee, Mississippi and Arkansas.

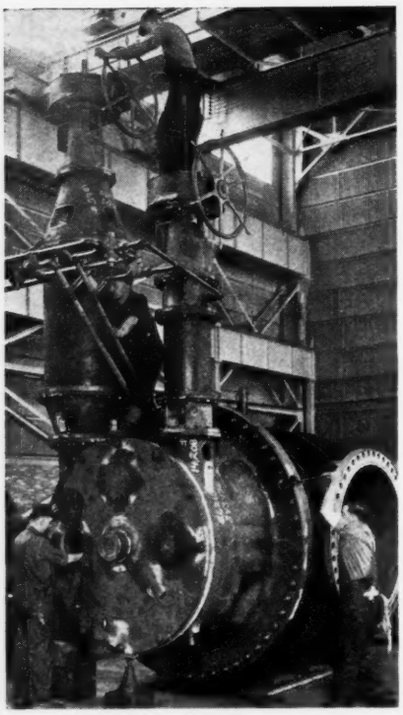
RILEY STOKER CORP, Worcester, Mass., has reestablished its Cleveland office at 1740 E 12th St. C A McConville will be district manager of the new office. R B Hill has been appointed manager of the Buffalo office, and J B V Coburn, Jr, sales engineer at the Cincinnati office.

REPUBLIC FLOW METERS Co, Chicago, Ill., has moved its New York sales office, as well as its engineering and service departments, to the Graybar Bldg, 420 Lexington Ave. M N Dannenbaum Co, Petroleum Bldg, Houston, Tex., has been appointed representative for southern Texas. Cowles & Co, Mercantile Bldg, Dallas, Tex., will render a similar sales and engineering service throughout northern Texas.

ALLEN-BRADLEY Co, has moved its St. Louis office to 404 N 17th St. G W Schalchlin is district manager.

MORSE CHAIN Co, Ithaca, N. Y., has appointed Harold J Skidmore manager and superintendent of its Detroit plant to succeed C B Mitchell, resigned. L D Worden has been added as assistant sales manager in charge of industrial products manufactured in Detroit.

R K MANGAN has been appointed vice-president of The Buda Co in charge of advertising, domestic and export sales of diesel and gasoline engines. Mr Mangan has been associated with The Buda Co in an engineering and sales capacity for approximately 20 years.



*THROTTLE CONE*

**This 54-in. S Morgan Smith cone valve on the Mono Lake development of the City of Los Angeles water system is used as a throttling outlet valve for the Long Valley reservoir and operates under 117-ft head. It weighs about 65,000 lb and is stainless-steel clad. The valve may be operated manually, hydraulically, or electrically, which accounts for the large amount of control equipment**

## STRAWS

**Pointing the way business winds blow**

**ALABAMA**——Robertsdale is considering municipal electric plant. Estimates of cost are being made. Financing will be arranged through Federal aid. F N Farrington and H L Minter, Dadeville, head project to construct and operate cold-storage and refrigerating plant. Work scheduled to begin soon. Cost about $35,000, with equipment.

**ARIZONA**——U. S. Indian Service contracted Nordberg Mfg. Co for complete generating unit at $165,043, for extension in existing power plant at San Carlos Indian Irrigation project, Coolidge.

**CALIFORNIA**——Glendale plans municipal steam-electric plant, and has authorized financing for $1,500,000 through Federal aid for project. E A Ingham, city manager, in charge.

Board of County Supervisors, Los Angeles, plans central-heating plant, with two boilers and auxiliary equipment, in naval reserve armory on Chaves Ravine Blvd. near Figueroa St. Cost about $1,000,000. Stiles O Clements, Van Nuys Bldg, Los Angeles, architect.

Water Dept, Fresno, will take bids soon for 100,000-gal. steel storage tank at Pearl and M Sts. Alternate bids will be asked for concrete tank, same capacity. Cost about $97,000. Financing in part through Federal aid.

Bureau of Yards and Docks, Navy Dept, will complete plans soon for extensions in power plant at Mare Island, Navy Yard, including watertube boiler with water-cooled walls, rating of 120,000 lb per hr; superheater, air preheater, combination oil and gas burners, combustion air ducts,

*(Continued on page 110)*

# NEW PLANT CONSTRUCTION

*McGraw-Hill Business News Department Is Prepared to Furnish a More Complete Daily Service*

**Ark., Hot Springs**—Arkansas Power & Light, Pine Bluff, making plans constructing combined flood control and power dam on Ouachita River, 14 mi. northwest of here. $6,000,000. C. S. Lynch, Pine Bluffs, engr.

**Calif., El Centro**—Imperial Irrigation Dist., El Centro, plans constructing 1 story, rein.-con. sub-station, 3rd St. between Orange and Holt Sts. $85,000. M. J. Dowd, El Centro, engr.

**Calif., Mare Island**—Yards & Docks, Navy Dpt., Wash., D.C., taking bids 120,000 lb. per hr. boiler with water cooled walls superheater, air preheater combination oil and gas burners, forced and induced draft fans, combustion air ducts, soot blowers, structural steel supports and accessories for Mare Island, Spec. 8807.

**Conn., Derby**—Derby Gas & Electric Co., 22 Elizabeth St., brick, steel, concrete power plant, incl. boiler and turbine, Housatonic Ave. Est. $80,000. Owner builds under direction of Gibbs & Hill Co., archts. and engrs., Penna. Station, New York.

**Fla., Miami**—City making plans and specifications for constructing electric power plant to furnish power for waterworks. $180,000. C. F. Lambert, electrical engr.

**Ill., St. Charles**—City, City Hall, soon lets contract constructing power plant and offices, Main St. $100,000. H. Zook, 140 South Dearborn St., Chicago, archt.

**Ind., Richmond**—Bd. P. Wks., J. M. Walterman, chn., City Hall, soon lets contract furnishing auxiliary equipment for new boiler, combustion control unit, instruments, panel board, forced draft fan, induced draft fan, c.i. ash hopper, stack, feed water regulator.

**Ia., Ames**—Iowa State College, Ames, plans steam boiler and heating equipment. $250,000. State Bd. Educ. has asked State Legislative interim committee for funds. Maturity in 1939.

**Ia., Belmond**—City, c/o C. L. Courtney, clk., defeated $120,000 bonds constructing municipal light and power plant building and equipment, etc.

**Ia., Cedar Falls**—Iowa State Bd. Educ. approved $45,000 expenditure for additional generator for heating and power plant of Iowa State Teachers College.

**Ia., Dayton**—City voted $55,000 bonds constructing new light plant. $50,000. R. W. Gearhart, 349-21st St. S.E., Cedar Rapids, engr.

**Ia., Muscatine**—First Iowa Hydro-Electric Cooperative Co., F. A. E. Gilmor, pres., Donohoe, J. M. Roth, secy., plans constructing and equipping plant to manufacture, generate, transmit and distribute electricity.

**Ia., Sibley**—City plans improving municipal electric light and power plant, incl. $53,000 turbine, cooling tank and enlargement of plant. $151,000.

**Ia., West Liberty**—City, c/o City Clerk, constructing 35x38 ft. power plant addition, 24 ft. high and 31x35 ft. addition to water plant, 16 ft. high, used for iron removal for town's water supply, brick, stucco. W.P.A. labor. W.P.A. grant $10,928 available. R. E. Wilkerson, Muscatine, engr.

**Mich., Dowagiac**—C. Huff, city clk., soon lets contract reconstructing 2 story, brick, steel, rein.-con. power house. Est. about $50,000. Ayres, Lewis, Norris & May, Ann Arbor, engrs.

**Mich., Northville**—Bd. Auditors, Wayne Co., J. C. Cowan, chn., Wayne Co. Bldg., Detroit, soon lets contract constructing and erecting 1 multi-cylinder vertical uniflow engine of heavy duty poppet valve type and direct connected to 300 kw. alternate current generator and V-belt driven exciter at Wayne County Training School. N. O. Gould, 301 Boyer Bldg., Detroit, engr.

**Minn., Chisholm**—City, c/o F. W. Hurt, clk., plans election to vote $356,000 bonds toward construction power plant, generating equipment and electric distributing system. $647,000. P.W.A. has approved project, subject to congressional appropriation of funds. Franchise of private power company serving city expired in 1935.

**Minn., Janesville**—City, G. Smith, clk., plans nearing completion by G. M. Orr & Co., engrs., 542 Baker Arcade Bldg., Minneapolis, constructing electric power plant, generating equipment and distribution system. $100,000. Bonds voted late in 1935. P.W.A. allotment made October, 1935.

**Mo., Caruthersville**—City, c/o Mayor, plans constructing municipal light and power plant and distribution system. $175,000. Burns & McDonnell Eng. Co., 107 West Linwood Blvd., Kansas City, Mo., engrs. Application made to P.W.A. for funds to finance construction.

**Mo., Chillicothe**—City, final plans in progress and takes bids early in July, for ash and coal handling equipment, also power wiring and power piping on new power plant addition. Henrici-Lowry Eng. Co., 114 West 10th St., Kansas City, Mo., engrs.

**Neb., Grand Island**—City, c/o Clerk, bids in about a month for boiler settings $10,000, and fans and auxiliary equipment $35,000, for power plant. Total est. $80,000. Black & Veatch, 4706 Bway., Kansas City, Mo., engrs. G. Shattuck, Grand Island, archt.

**Neb., Neodesha**—City plans constructing power plant improvements and new 1,500 hp. turbine. $150,000. Black & Veatch, 4706 Bway., Kansas City, Mo., engrs.

**N. Y., Oxford**—Commissioner Social Welfare, 112 State St., Albany, soon lets general contract heating, sanitary and electrical work for constructing boiler plant and laundry building at New York State Women's Relief Corps Home, Spec. Nos. 9778, 9779, 9780 and 9781. $250,000.

**O., Fairport**—City, election Aug. 9, to vote $89,000 bonds constructing electric light plant. $155,000.

**O., Logan**—City plans constructing municipal power plant. D. Kinser, mayor, recommended construction of same.

**O., Middletown**—City, W. Brown, mgr., considering ordering survey for constructing new municipal electric power plant. $2,500,000.

**Okla., Anadarko**—Bids July 15, by N. Kunkel, engr., Anadarko, furnishing one 750 hp. Diesel engine, one 500 kw. generator and exciter, one 11 panel switchboard. Est. $90,000.

**Okla., Blackwell**—City made preliminary plans new steam boiler for power plant. $25,000. Black & Veatch, 4706 Broadway, Kansas City, Mo., engrs.

**Pa., Danville**—Boro Council, plans purchasing, installing ammoniator at municipal water supply plant, also pumping equipment for well now being drilled in Susquehanna River to augment water supply. $1,000. Maturity soon.

**Pa., Ephrata**—Borough Council plans purchasing electrical pumping machinery, settling tanks, sludge digesters and other equipment for sewage disposal plant, also various size sewer pipe for sewerage system. To exceed $1,000. W. A. Goff, 220 South 16th St., Phila., engr.

**Pa., Sayre**—Borough sketches constructing new municipal light, heat and power plant, distribution lines. $550,000. H. S. Child, Sayre, engr.

**Pa., State College**—General State Authority, A. S. Janeway, executive dir., 600 North 2nd St., Harrisburg, soon lets contract alterations and additions to power plant equipment, Contr. 40, for state college, incl. demolition and removal of present structural steel foundation supporting the existing 750 kw. turbine-generator; renovating existing 1,250 kw. turbine-generator and installing surface type condenser therefor, complete with pumps, piping and appurtenances; drilling two 12 in. deep wells, supplying turbine type deep well pumps and piping for circulating water to condenser, drain lines from condenser to storm sewer, safety valve piping and miscellaneous piping changes incidental to turbine generators; new foundations for 2,500 kw. turbine generator, electrical wiring and switchboard changes. $40,000. Hunter & Caldwell, 3601 Fifth Ave., Altoona, archts. C. Z. Klauder, 1429 Walnut St., Phila., and Altoona, assoc. archt.

**South Carolina**—South Carolina Public Service Authority, c/o B. R. Maybank, chn., Southern Home Bldg., Charleston, making plans constructing Santee Cooper Hydro-Electric and Navigation Project. $37,000,000. Harza Eng. Co., 27 Cumberland St., Charleston, S. C., and 205 West Wacker Dr., Chicago, Ill., engrs.

**Tex., Brownwood**—Howard Payne College, c/o T. H. Taylor, pres., making surveys constructing physical education building, gymnasium, dormitory, administration, museum, power plant, etc.

**Tex., Crosbyton**—City voted bonds constructing municipal power and light plant. $94,000.

**Tex., Liberty**—City, c/o L. C. Steusoff, secy., soon lets contract constructing power plant, electric lighting and power system and distribution system. $115,000. Jarrett Eng. Co., 308 Hughes St., Houstson, engrs.

**Wis., Richland Center**—City plans installing 1,250 kw. steam turbine to augment present municipal utility generating equipment. $83,000.

**Newfoundland, Cornerbrook** — Bowater Co. Ltd., 121 Queen Victoria St., London, Ont., making plans improving Deer Lake power plant. $200,000.

**Que., Noranda**—National Electricity Syndicate, S. A. Bauline, chn. Quebec City, making plans constructing hydro-electric power development on Lake Decelles, Upper Ottawa River, 35,000 hp. $5,000,000. Maturity 1938. Private plans.

**Que., Sault Au Cochow**—National Electricity Syndicate, S. A. Bauline, chn. Quebec City, making plans constructing hydro-electric development, 80,000 hp. $6,000,000. Private plans.

**T. H., Hickam Field**—Bids July 27, at office Con. Q. M., Fort Mason, San Francisco, Calif., constructing and completing street lighting system and secondary electric distribution system at Hickam Field.

**Alaska, Ketchikan**—Ketchikan Public Utilities plans installing new turbine generator with connecting tunnel to provide additional current facilities. $50,000.

# THAT VITAL LINK *Between Motor and Machine*

## HOW THE MAGNETIC CLUTCH OPERATES

Everyone is familiar with the pull of a horseshoe magnet on a piece of iron. The principles involved in C-H Magnetic Clutches are exactly the same—except that in these Clutches magnetic action can be turned on or off at the press of a button.

# CUTLER-HAMMER
# MAGNETIC CLUTCH

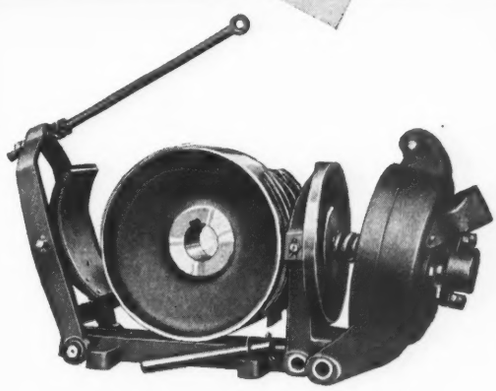
The need for smooth, efficient power transmission is increasing every day. Plant owners and machine designers recognize that the C-H Magnetic Clutch is the most dependable link between motor and machine . . . the one type of transmission that provides gentle engagement, jerkless pick-up and continuous efficiency entirely independent of the operator's skill.

It is, without question, the most controllable type of power transmission and a recognized safety factor to machines. C-H Magnetic Clutches can be controlled automatically, manually or remotely. They slip or disengage at any pre-set torque. Actuated by limit, pressure, float, time or temperature switch, they provide precise cyclic or occasional coupling or uncoupling. In fact, C-H Magnetic Clutches can be made to respond to any changing condition.

Every Cutler-Hammer Magnetic Clutch is precision built, rugged and made to *last.*

From the smallest clutch to the great 78 inch giant, each one is designed and manufactured according to the same high standards that have earned C-H Equipment such outstanding preference. Remember, there is a C-H Magnetic Clutch for every drive or purpose — pointing the way to *better machine performance for you.* Write—specifying Torque, Speed and Space. CUTLER-HAMMER, Inc., *Pioneer Manufacturers of Electric Control Apparatus,* 1364 St. Paul Avenue, Milwaukee, Wisconsin.

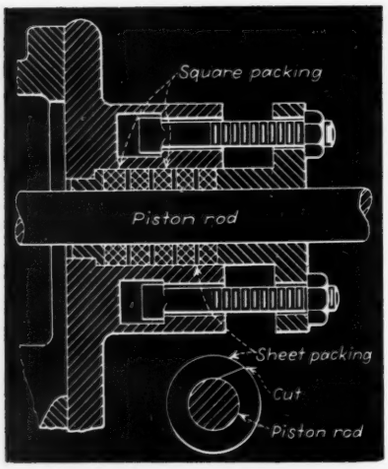
CUTLER-HAMMER
MOTOR CONTROL
C-H



### WHEN YOU WANT TO STOP—

Cutler-Hammer Magnetic Brakes will do it more efficiently. Here is a more direct application of power than is found on any other brake. No toggles, no bell arms, no power transmitted in *any* roundabout way. The number of installations proves C-H Brakes give better, more effective stopping power and less trouble. They also last longer and are equally effective on either "forward" or "reverse". Investigate.

# Practical Aids to Operation




## Sheet Packing For Piston Rod

ON A STEAM engine using wet steam, where I had difficulty keeping the piston-rod packing tight, I used the arrangement in the figure. Between each section of regular packing I placed a ring of sheet packing of the type used for cylinder-head gaskets. This simple little trick solved the packing problem and provided a use for small pieces of packing that were generally wasted.

*Sloat, Cal.* R L BROWN

## Clean Steam Lines Before Installation

WHEN steam lines are installed, every precaution must be taken to see that dirt and other foreign objects are removed from pipe and fittings before they are erected. Neglect of this important point may result in numerous operating and maintenance difficulties after the line is placed in service. In one case, a small stone overlooked during erection was responsible for water-hammer troubles in the steam-distribution piping of a large industrial plant. This seemingly insignificant object found its way to a drip pocket and lodged in the inlet piping of the drain trap, completely blocking condensation removal at this point.

When the cause was discovered the main was temporarily removed from service and the plugged piping presumably opened by moving the obstruction to one side with a rod. When steam was again admitted to the main, however, the stone resumed its former position, again plugging the drain.

Consideration was then given to cutting out the bottom of the drip pocket, removing the stone and welding the bottom back in place, but it was finally decided to extend the drip pipe two inches into the pocket. This solution eliminated all trouble caused by the stone and also prevented leakage formerly experienced around the threads of the original drip connection.

*Roanoke, Va.* S H COLEMAN

## Ways of Reducing Starting-Up Steam

A MAJOR operating difficulty, experienced in boiler plants serving industries that start up and shut down all steam-using equipment one or more times each day, is maintaining steam pressure and keeping boiler-water level under control during starting-up periods. If steam-admission valves of all process operations are simultaneously opened wide, with the boilers idling, a serious reduction in pressure will occur, accompanied in many instances with a dangerous carryover of boiler water.

It is often possible to prevent such occurrences by scheduling operations. Where cooperation from the operating departments cannot be obtained, the engineer has other means of relief. He can throttle the main steam valve to the plant until the fires catch up with the load. Where the heavy starting demand comes from certain pieces of equipment, orifices may be put in the lines to these machines. These orifices should have openings large enough to take care of normal running-load peaks but small enough to hold the starting load within desired limits.

*Richmond, Va.* C R ANDERSON

## When the Engineer Went Home

AN INCIDENT occurred recently that emphasizes the dangers of allowing unauthorized persons in a boiler room. Several cross-drum watertube boilers supply steam for power generation and building heating. They are oil-fired, and operate from 6 am to five in the afternoon. It is the practice of the engineer to shut off the burners at about 4:30 pm and allow pressure to work down to about one-half of operating value before closing the main stop valves and going home.

During a cold spell, some of the office help were working in the evening, and more heat was desired. One of them, knowing much about valves but little about plant operation, went to the boiler room. Observing moderate pressure on the gages, he climbed up and opened the main stop valve of one boiler. Nothing was done further, and the stop valve was left open for the night.

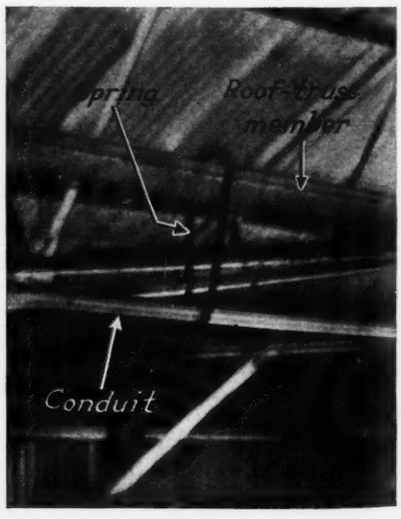
When the engineer entered the plant the following morning, he found the boiler room flooded with water, and pressure down to zero on the boiler with the open stop valve. Examination disclosed that the top two rows of tubes were distorted and leaking at the expanded ends. These tubes had to be replaced, and needless to say, a general order was issued to keep anybody except an engineer from operating any valve.

The brickwork was at high temperature in this boiler when it was left for the night, and when the stop valve was opened, steam flow and evaporation of water in the boiler caused the water level to drop. As the condensate returns went to a hot-well receiver, and the feedwater pump was not started, water level dropped to uncover the two top rows of tubes before the brickwork cooled sufficiently to stop evaporation.

*Chicago, Ill.* C A ARMSTRONG

## Spring Mountings Save Light Bulbs

ONE of the principal maintenance chores in a gas-compressor station powered by 16 twin units was the replacement of light bulbs. Engine-room illumination was furnished by pendant



# "YARWAY TRAPS So Efficient—We Are Replacing All Other Types"

. . . Says World's Largest Cleaning and Dyeing Plant.

North Side Cleaners and Dyers Co., Chicago, said to be the largest plant of its kind in the world, are enthusiastic rooters for Yarway Impulse Steam Traps. With 32 Yarways now installed on unit heaters, gasoline stills, presses, headers, tumblers, etc., they say, — *"We are gradually replacing all other traps in the plant with this type because we have found Yarways so efficient in performance."*

Why don't you end your steam trap troubles by standardizing on Yarway Traps for *quicker heating* and *greater sustained heating efficiency;* for their *lower installation and maintenance cost;* for their *fuel economy;* for their *saving in valuable floor space* around machines and for their applicability to practically all trap needs. *(Same valve seat for all pressures without change.)*

You probably can install Yarways for as little as it will cost to repair old traps in your plant. This is often the case. See your Mill Supply dealer—or write for Catalog T-1733.

**YARNALL-WARING COMPANY, 100 Mermaid Ave., Philadelphia**

## YARWAY IMPULSE STEAM TRAP

fixtures, carried on short nipples from conduit attached directly to the roof trusses.

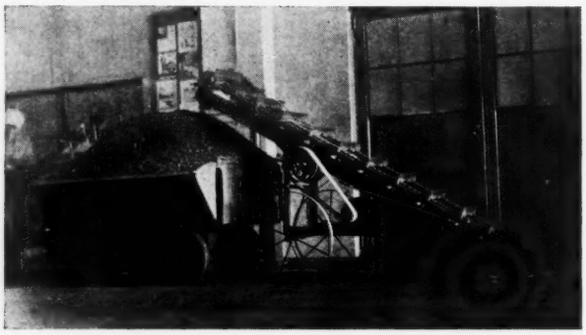
With lights under the roof trusses, and twice that number on wall brackets at either side of the units, the toll of bulbs through excessive vibration was serious. Sometimes the lamps caused operating difficulties by failing when a unit was down because of some mechanical fault.

Realizing that most of the failures were due to building vibration, all conduits were cut free of the steelwork, and supported in slings made from ordinary screen-door springs. The sling was passed around the conduit and truss member, and the ends hooked together, as in the figure. We also spring supported switch boxes at the ends of the building and over the engineer's desk. This reduced bulb failures to less than 25% of the former number.

*Longview, Texas* M T PATE

## Home-Made Coal Loader Eliminates Shoveling

WHEN appropriations are not available for purchasing equipment, there remains the possibility of making a substitute. This was our case when we needed a portable coal loader. The



photograph shows the results of our efforts.

This loader is made from scrap iron taken from the plant's junk pile at a cost of approximately $10.00, (not counting the motor). It will load 2000 lb of crushed coal in 3 to 4 min. The frame is constructed of a 1.5-in. angle iron riveted at all joints, with the bottom or slide and the sides made of No. 11 sheet iron.

Top bearings of the conveyor shaft are mounted on the frame and the lower shaft has its bearings supported by two 1-in. pipe arms hinged from the upper shaft. Rigidness between these two arms is obtained by welding a cross piece at each end and in the center. This lower bearing mounting allows the lower end of the paddle chain to climb up if the coal should slide into the loader faster than it can be carried away. The paddles will then work downward until the lower shaft rests on its supports, which prevents the paddles from riding on the slide bottom.

The arms supporting the lower bearings also serve as a slide for the empty paddles on their return. Paddles 24x4 in. are made of No. 11 sheet iron and are attached to two No. 55 malleable-iron chains and travel at a speed of 90 fpm, driven by a 1-hp enclosed motor. When operating the loader, the coal wagon is backed up against the bumper of the loader to force it into the coal pile. As the action of the paddles helps pull the machine into the coal little effort is required of the operator.

*Harvey, N. D.* O HOPSCH

## Metal Strips Protect Heat Insulation

WHERE heat insulation on pipelines is subject to mechanical injury, maintenance costs can be reduced and the general appearance of the plant improved by placing protecting sheet-metal shields around the outside of the covering.

In a large industrial plant, these shields are put where the insulation must be frequently walked upon, climbed over or where ladders are placed against it. Where chains of overhead chain-operated valves rub against lines when valves are operated, covering on this piping is also sheathed with metal to reduce damage from abrasion.

*Roanoke, Va.* S H COLEMAN

## Work Bench for Servicing Elevators

TO EXPEDITE servicing of our elevators, we provide a work and test bench (see photo) in each elevator-machine room of the Bank of Manhattan Bldg. A drawer in the bench stores tools usually not carried by the elevator mechanics. Fastened to one

corner of the bench is a vise for ready use. On the upper left-hand corner of a panel on the back of the bench is a fuse tester comprising two metal bars, one of which is connected to a lamp. The lamp and other bar connect to the test circuit. At their top ends the bars are spaced so that the ferrules on the standard 5- to 30-amp cartridge fuse will make contact with them. At their lower ends, the bars will contact 600-amp, 220-volt enclosed fuses.

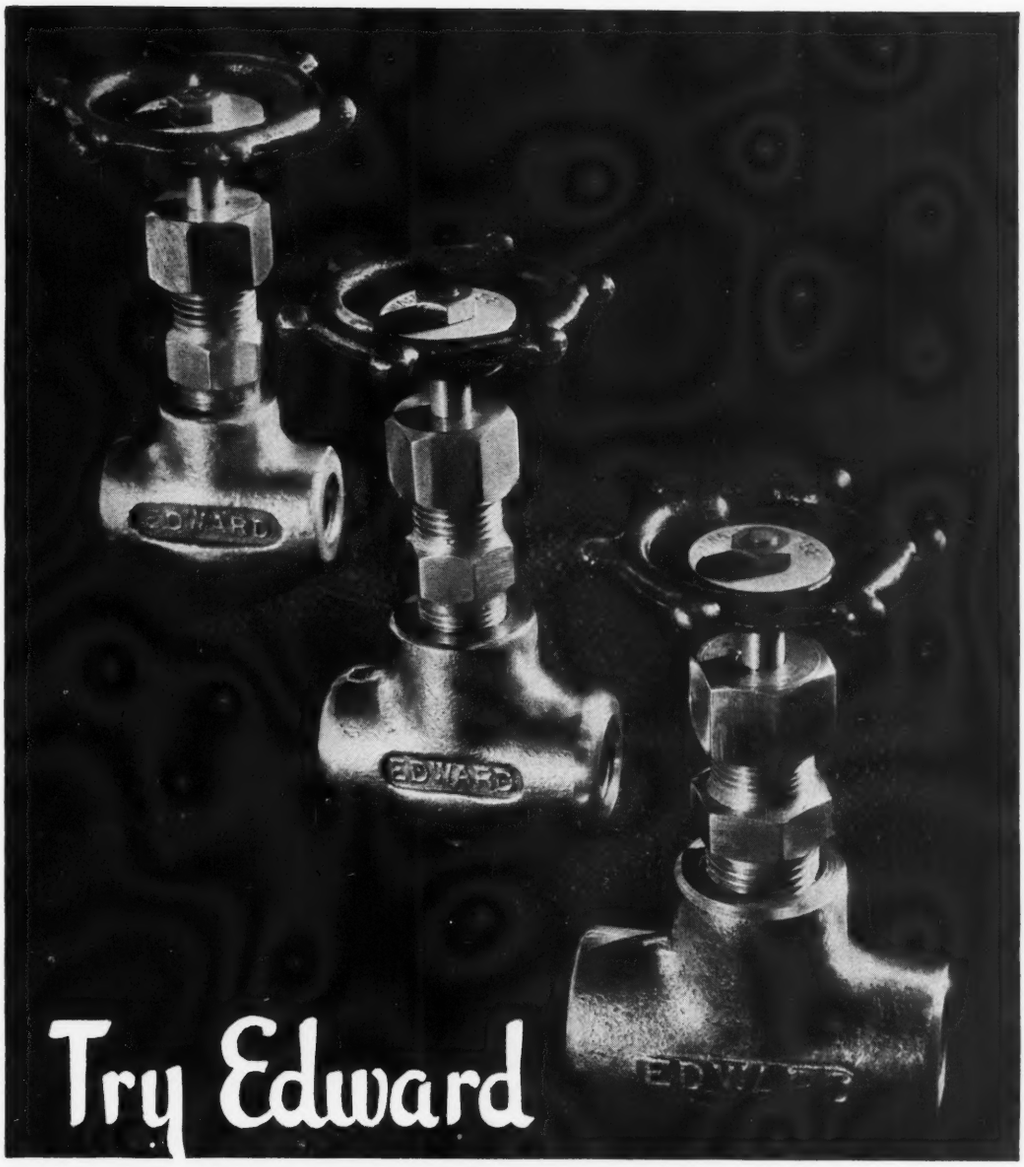
A rack on the panel provides storage for the different sizes of fuses used in the elevator-power and -control circuits. Space is provided for each size fuse and each size is painted a different color. This color identification has proved to be very convenient. The mechanic replacing a fuse does not have to think about its size, but only its color. It also insures against using fuses of different sizes on the same circuit.

*New York, N.Y.* WM DEVAUGHN
*Elevator Engineer*

## Operation of One Burner Causes Boiler Corrosion

MANY causes of corrosion have been brought to the attention of POWER readers. However, every now and then a case crops up that is rather mystifying to the plant operators until a little study has been given to the matter. This was the case with a 1500-sq ft hrt boiler. The boiler operated at 125 lb per sq in steam pressure, and was fired by two oil burners, side by side. During recent years of depression, demand for steam was low and one burner was used alone much of the time.

On opening the boiler for cleaning and inspection recently, it was found that the lower part of the rear course of shell plate was becoming seriously deteriorated by internal corrosion.




# FORGED BODY Gage Valves

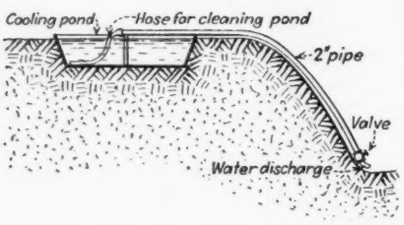
HAVE you ever used these sturdy low-priced needle valves? Every plant has places for them. Good for pressures up to 4000 pounds, these drop forged body valves save money in ordinary service. Each part, true to Edward quality tradition, is just right for its job. The latest improved series, shown in the photograph in sizes ¼", ⅜" and ½", has everything . . . titegrip malleable handwheel . . . safety taper-threaded bonnet joint . . . wearing parts hardened for long life . . .tailor-made packing in deep stuffing box . . . packable under pressure . . . carbon and alloy steels for special services. Stocked for immediate delivery.

**The Edward Valve & Manufacturing Co., Inc.**
EAST CHICAGO « « » » INDIANA

This area was localized on the left-hand side, for about 5 sq ft at the left of the blowdown opening. After some speculation as to the cause, it was realized that one factor which tied up with the location of the trouble was that the one burner which was used alone was usually on the left-hand side of the furnace. A second factor contributing to this difficulty was that raw feedwater was being introduced through the blowdown line. Oxygen in feedwater is ready to accelerate internal corrosion almost always, and where evaporation rates are localized, it may be almost certain that corrosion will be localized likewise.

Preventative measures, in this specific case, consisted of operating both burners with smaller tips so that a more equalized furnace temperature would result. The second fault was removed by relocating the feedwater discharge so that it entered the boiler near the water line so that dissolved oxygen could escape freely into the steam space.

*Cleveland, O.* A G WIGGINS




## Syphon Cleans Cooling Pond

PLANT OPERATORS having to clean muck and sediment from cooling ponds will be interested in the method we use to do this job. Our cooling pond is on a hill about 30 ft above a small water course. We installed a 2-in. pipe from the bottom of the hill up to the center of the cooling pond and there attached a 2-in. hose long enough to reach any part of the pond, as in the figure. At the lower end of the pipe we placed a 2-in. gate valve. Solely long bends are used to keep friction in the line at a minimum and to prevent scale from clogging the pipe.

Filling the syphon pipe from its lower end eliminates all air pockets. When the line is filled, the gate valve is closed, the hose removed and everything is ready to start cleaning the pond. The syphon head, about 30 ft, gives a suction on the end of the hose in the pond sufficient to pick up anything that will go into the line and hold anything on the end of the hose that will not go into it. We use a piece of 2-in. pipe 3.5 ft long on the end of the hose as the cleaning tool to reach to the bottom of the pond.

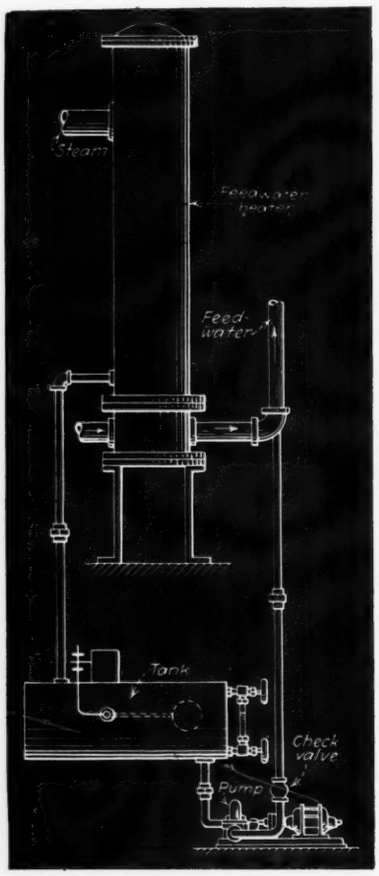
Occasional lifting the tool away from the bottom into clear water will clear the line of solid matter and prevent clogging. The bottom of the pond is cleaned of every particle of dirt and left cleaner than if swept with a broom.

*Shiprock, N. M.* J F MAHER

## Tank Solves Condensate Removal

THE PROBLEM of removing condensate from a vertical feedwater heater using steam bled at pressures below atmospheric, was solved in our plant in a simple manner. Condensate from this heater is pumped into the outlet feedwater line. This type of heater does not use a hot well, so the pump had to run continuously. At periods of light load the pump would vapor bind. It was also almost impossible to keep the pump packing tight enough so that air would not enter along the shaft.

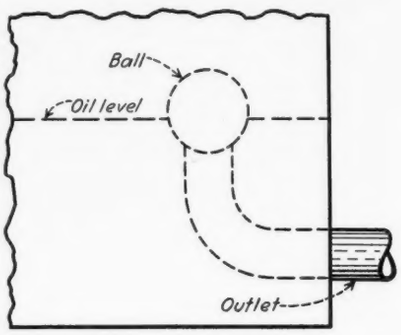
We decided to build a condensate receiver and install it over the pump, as in the figure. This tank was made from a piece of 12-in. pipe with welded heads. The pump was vented to the top of the tank so that the casing would never air or vapor bind. A float was installed in the tank to operate a 2-pole float switch, which was connected to the motor. This tank has been in operation for 6 months without the least trouble. The pump never gets vapor or air locked and it runs only part of the time, thus saving electric power.




*Mitchell, S. D.* L M WHITE

## Floating Balls Stop Flow From Tanks

TROUBLE was experienced with oil pipelines becoming air bound. Oil was pumped from tanks and the operators were supposed to switch over

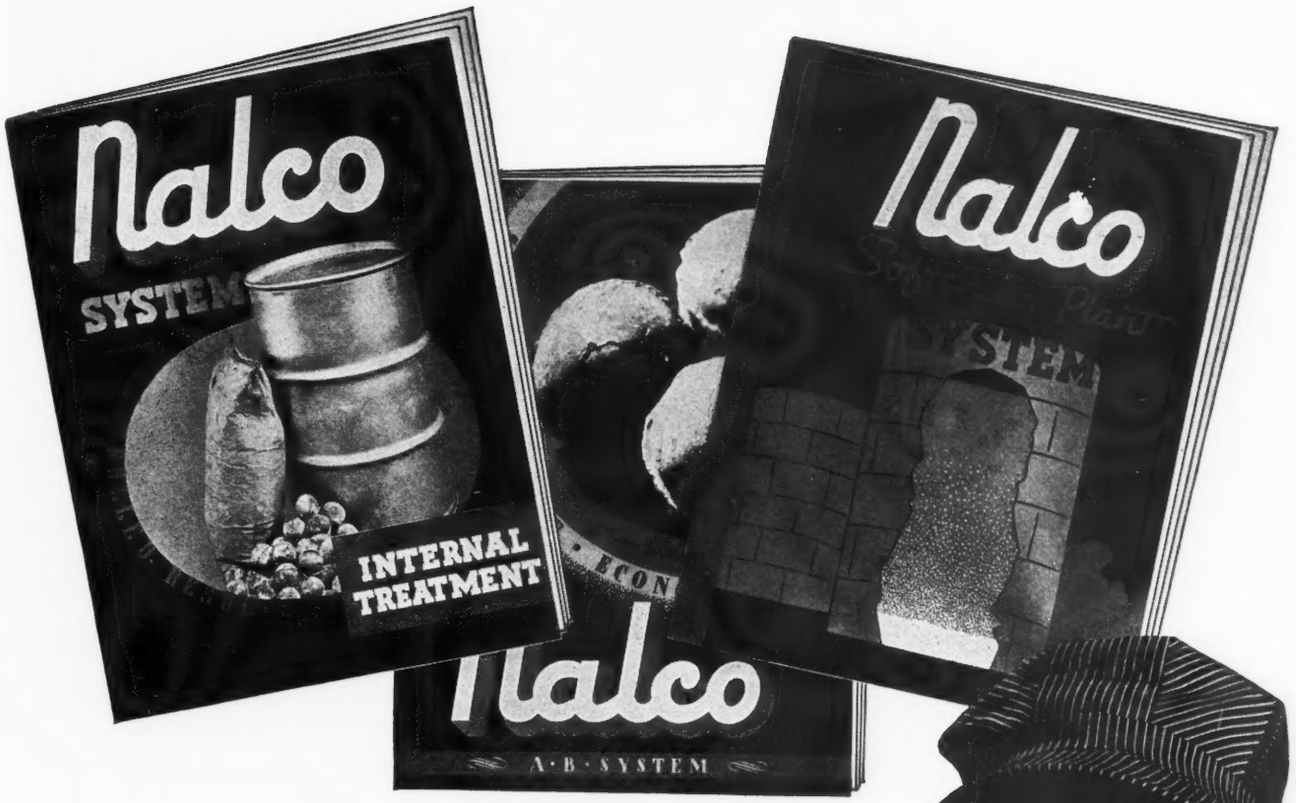



to a full one before the one being pumped reached a level that would let air into he line. The human element failed all too frequently. To eliminate this difficulty, a round wooden ball was tried as a check valve to close the end of the intake pipe when the oil surface dropped too near the trouble elevation.

Floating on the liquid, the ball gradually works down the slight slope existing on the surface—this slope being caused by flow into the upright riser fixed in the end of the delivery line. As this depressed area descends in the tank, the check ball drops with it holding its position directly above the outlet as though held there by guide rods. When the level has lowered enough for the ball to contact the nipple, it will land as in the figure, cutting off flow as effectively as a hand-operated valve. When the tank is again filled, the ball will float free from its seat, leaving the tank again ready for discharging as soon as the outside control valve, closed before refilling, is again opened.

Turned from cypress or redwood for water tanks, and of any close-grained wood and painted for fuel-oil containers, the balls last indefinitely, presenting a new surface each time to the seat in the pipe nipple, and thus automatically avoiding channelling or scoring. If the ball diameter be at least 1.5 times the nominal diameter of the nipple, no trouble will be encountered from the ball wedging in the outlet.

*Longview, Tex.* ELTON STERRETT




# CUT COSTS!

## —here's how:

**WHEN you are hunting for ways to cut costs, don't overlook the opportunities offered by the Nalco System of Feedwater Treatment: Lower fuel bills . . . higher boiler efficiency and capacity . . . fewer tube purchases . . . little or no expense for cleaning . . . savings in chemicals—these are some of the many benefits reported by Nalco users!**

**Nalco offers water treating service to fit *all* needs. Copies of the new bulletins pictured above will be mailed to any interested reader without obligation—just mention the kind of treatment you are interested in. NATIONAL ALUMINATE CORPORATION, 6222 W. 66th Place, Chicago, Ill.**

ANY WATER **NALCO SYSTEM** ANY PRESSURE

Inquiries other than domestic, *except those from U. S. Possessions, Canada and Mexico, should be addressed to* ALFLOC LTD., Bush House, Aldwych, London, W. C. 2, Eng. Canadian inquiries should be sent to ALUMINATE CHEMICALS LTD., 372 Bay St., Toronto, Ont.

# Readers' Problems

## *Questions for Our Readers*

### Keeping Boilers Clean

#### *Question 1*

OUR FEEDWATER *contains 25 ppm silica, 10 ppm iron, and 51 ppm of non-incrusting solids. Can some* POWER *reader tell me if phosphate will keep our boilers clean? If so, should I use trisodium or disodium phosphate? How do I arrive at the amount to use?*—JDO'N

### Aligning Line Shafting

#### *Question 2*

WOULD *some* POWER *readers tell me the best way to align line shafting, especially whether it should be aligned with the belts on or off the pulleys? It seems to me that if it is done with the belts off the pulleys, the increased loading when the belts are put on will cause misalignment. I believe that alignment should be checked under operating conditions, or as close to these conditions as it is practical to go.*—CAA

Suitable answers from readers will be paid for if space is available for publication.

### Waste-Fuel Plant

#### *Answers to June Question 1*

##### *The Question*

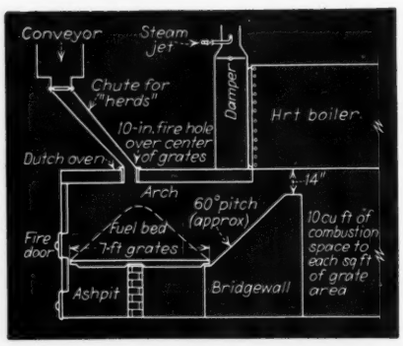
WE ARE BURNING *"herds" or "shives", the residue from the manufacture of hemp fibre, having the consistency of sawdust. The boilers are 72-in. x 18 ft. hrt's of 1500 sq ft each. Four are installed, all served by a 75-ft brick stack, only about 4 ft square at the base. Only one boiler is now used, at about 100% rating. The furnace is a Dutch oven having "V" grates with a Murphy stoker. (See June* POWER, *p351, for sketch). Herds are blown into the furnace. Coal must be burned at all times, and if we want to force the boiler we have to feed considerably more coal to burn completely the heavier supply of herds. There is a good deal of backfiring, especially when feeding the herds heavy, and at times the heat from the furnace ignites the coal in the hoppers. We blame this backfiring on poor draft.*

*We plan to remodel this plant and would like to get suggestions from* POWER *readers who have had experience in burning herds or similar fuel. We would like to avoid burning coal at all times, and to burn the herds most economically. It seems to us that the amount of air is insufficient, and we have no means of regulating it, except what comes in from the fan, as the damper in the uptake has no effect due to the low chimney. Suggestions for low-cost improvements will be extremely helpful.*—VTK

### Should Get 200% Rating

BURNING "herds," as I see it, is something like burning pine sawdust, and VTK should be able to get over 200% rating out of each boiler if he changes the construction to agree with the sketch. I am not sure that VTK's stack will handle the situation and suggest that an induced-draft fan be installed or a steam jet.

The sketch shows the boiler installation of the Quincy Lumber Co, at Sloat,




used for all kinds of sawdust, hog fuel, and box-factory refuse. There are four boilers, the largest a 1500- hrt and the smallest a 900-sq ft hrt. Each boiler has an individual stack 75-ft high, and as near as can be figured we get more than 35,000 lb hr out of this small battery when the box factory is running; in fact, it produces more steam per hr than any installation of its size in this locality.

*Sloat, Calif.* R L BROWN

### Furnace Volume Important

OUTSTANDING trouble with VTK's attempt to burn herds without coal is clearly shown in his drawing. Herds, bagasse, sawdust and other long-flaming fuels must have much more furnace volume for complete combustion than the usual varieties of coal. Such materials usually contain much water, even when steam dried, and cannot be forced to burn at high draft in a small space. With only one boiler in use, backfiring is certainly less from poor draft than from limited combustion space. If remodeling of the plant is to be undertaken, furnace volume should be kept foremost in mind. If headroom permits, boilers should be raised and volume of Dutch ovens increased also. Fifteen ft is not too high for a furnace designed to burn herds or like material. If headroom does not permit raising the boilers, furnace volume may be increased by lowering the grates and stokers.

I disagree with VTK's statement about the damper having no effect because of the low chimney. However, if boilers are to be operated at or above rating, an induced-draft fan would be a good investment. If flue-gas temperature is not so high at the uptake as to ignite the fuel, the gases could be drawn via ducts through the herds bin, drying out the fuel for more efficient combustion and reducing the volume of gas to be handled by the fan. If combustion is incomplete, secondary air may be admitted by ports in the sidewall, set as low as possible.

*Marissa, Ill.* GEORGE BLUM

### Control Fuel and Air Flow

THE GREAT majority of plants having a waste product that burns partially in suspension seem to overlook the necessity for controlling fuel flow and air flow. The same principles apply for this waste fuel as in the spreader stoker, pulverized-coal burner or oil burner. No one would think of operating any of these without a means for controlling the fuel feed and air supply yet they try to burn waste fuels by merely "dumping" them into the furnace. The first suggestion to VTK is to provide a means for controlling waste fuel by a suitable feeder and to control air supply.

Where a fuel is burned in suspension it is imperative that gas velocities in the furnace be kept reasonably low. Velocity is a function of draft, gas volume, and size of opening. In all probability the volume of this particular furnace is too small and gas velocity over the bridge wall is too great. If "herds" are blown over the top of the bridge wall as illustrated in the sketch it is likely that burning is not complete before precipitation occurs after the bridge wall. This is poor economy and may prove disastrous. The second suggestion is to increase the furnace volume to about 350 cu ft and increase the length of grates if necessary to prevent "herds" from going over the bridge wall. The opening between arch and bridge wall may also need more area.

The stack mentioned does not seem suitable for four boilers but should be sufficient for the operation of one boiler. The backfiring mentioned is not entirely due to draft conditions but more probably due to poor control of fuel and air feed. Draft over the fire should be only slightly negative. A large negative draft would be necessary to remove the "puffs" mentioned and it is questionable, even then, if backfiring could be eliminated with the present method of fuel feeding. Certainly a large negative draft is undesirable when we consider the greater amount of excess air that would filter into the furnace.

Frankly, the problem requires a lot more study than can be given it from

## HAGAN AUTOMATIC COMBUSTION CONTROL

# "Thinks" like an engineer

# ...acts *instantly!*

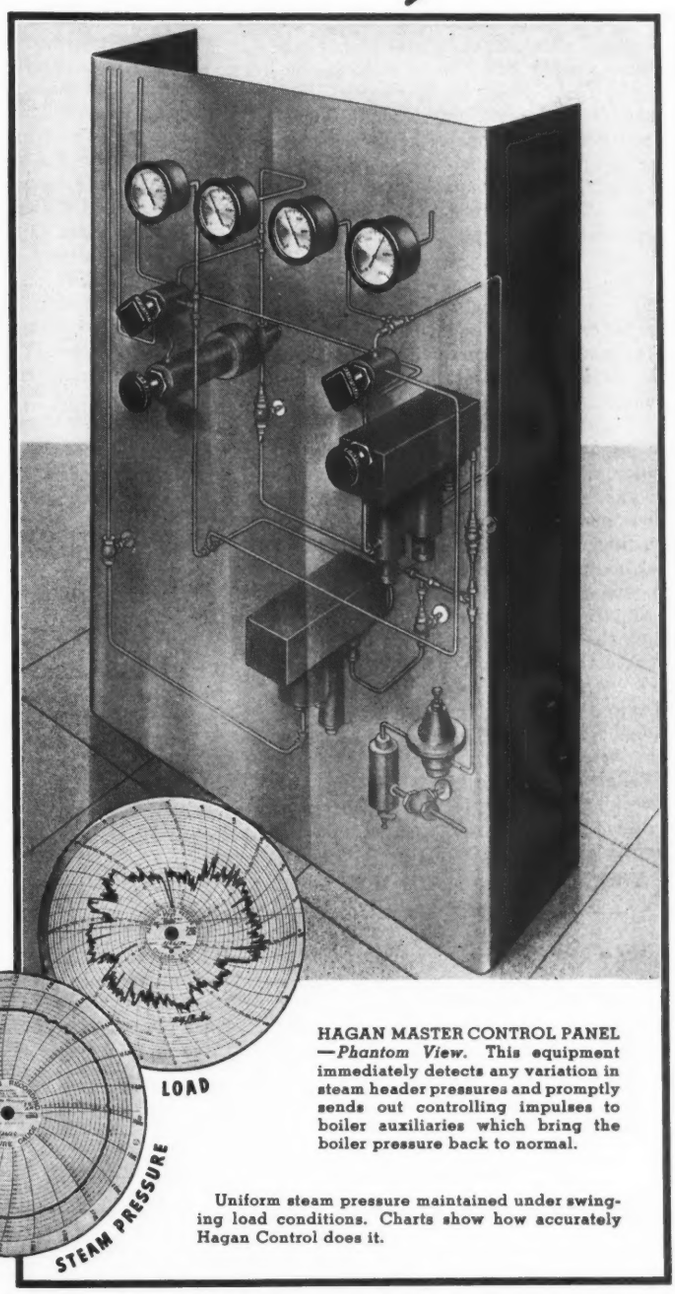
***Maintains Uniform Steam Pressure and Top Efficiency at Any Load***

WHEN it comes to combustion control, Hagan Automatic Equipment practically does the engineer's thinking for him. It actually detects changes in steam conditions before they become apparent—snaps into action—adjusts fuel and air mixture to the exact amount to maintain proper pressure—keeps the boiler working at highest efficiency.

All these operations are automatic and practically instantaneous. The most competent operator depending on manual equipment would find it impossible to maintain such constantly accurate control. The result is more economical boiler operation, quicker responses to load changes, proper division of the load between boilers, greater safety and utmost reliability.

Hagan, the pioneer and still the leader, designs control for all types and sizes of boilers for any load condition. Call or write us now. Our engineers will gladly study your equipment with an eye to lower operating costs.

**THE HAGAN CORPORATION**
300 Ross Street Pittsburgh, Pa.




HAGAN MASTER CONTROL PANEL —*Phantom View.* This equipment immediately detects any variation in steam header pressures and promptly sends out controlling impulses to boiler auxiliaries which bring the boiler pressure back to normal.

Uniform steam pressure maintained under swinging load conditions. Charts show how accurately Hagan Control does it.

***SEND FOR NEW FREE BOOK***

Hagan Automatic Combustion Control. The complete story in a beautifully illustrated 20-page brochure. Shows how Hagan Control improves the operation of all types of boilers.

## HAGAN *Automatic* COMBUSTION CONTROL

*The pioneer . . . and still the leader*

the information supplied. I would suggest that VTK engage a good power-plant consulting engineer in his locality to go over the problem.

*Milwaukee, Wis.* A G BEHLING

## Four Factors

FOR VTK to exercise control economically over his boiler operation, he must know four things: namely, percentage of $CO_2$ and CO, exit gas temperature, and boiler draft. As generally the greatest loss in burning a fuel is due to excess air, the percentage of $CO_2$ in the gas must be known to keep it to a minimum. A recording gage is justified in almost any plant. If this cannot be procured a hand Orsat usually can. With this, flue gas can be analyzed and the proper air-to-fuel ratio established. VTK would immediately know whether or not he is carrying a sufficient percentage of excess air.

Sampling in the 1st pass will tell him conditions in the furnace. If there is a deficiency of air the samples will consistently show CO. He can correct this by the use of secondary or overfire air. The amount that will have to be added for different loads can be determined with the Orsat, and a curve drawn to assist the firemen in maintaining the correct amount.

If heating surfaces are dirty or baffles are in poor shape efficiency will suffer, due to the increased temperature of gas leaving the boiler. A breeching thermometer can be read hourly and the reading recorded on a daily log sheet.

Finally, the boiler draft must be known so that the proper draft can be maintained. If excessive draft is carried, the breeching temperature will rise due to the more rapid flow of gas over the heating surfaces. Draft gages are cheap; two should be installed on each boiler, one on the furnace and one on the breeching. To better his draft, VTK should check all boiler settings and breechings for air leaks. Dampers on boilers that are not used should be tightly closed.

*Mitchell, S. D.* K M WHITE

## Low Cost Changes

ONLY A FEW installations burn herds or shives, so there is little information available. My company installed a furnace in the flax department of the Oregon penitentiary, and a sketch of the general layout is given which VTK is at liberty to adapt to his present layout. All mill waste, comprising shives, chaff, and sweepings, is burned along with hogged fuel.

In regard to backfire and high furnace temperatures, I do not believe this difficulty is due only to poor draft, since draft through an hrt boiler is largely dependent on total tube area and is naturally reduced by friction. Burning an excess of coal to maintain steam pressure, the combustion chamber is probably filled with gas from the coal, and there could be scarcely sufficient draft and velocity through tube area to take care of the instantaneous ignition of a sudden charge of shives. This is deduced from the furnace arrangement shown, where shives from the cyclone blow through a Dutch oven into a combustion chamber. The sketch shows the feed hole in the top of the oven, which permits considerable excess air, especially when used in connection with the cyclone, and will automatically prevent backfires and excessive furnace temperatures.

Flat grate bars are used and air is admitted over the grate bars through open ports in both center and sidewalls. This provides sufficient air to burn heavier parts of the shives which will not burn in suspension. In operation, the heavier parts fall on the center combustion pier, but burn rapidly enough to prevent covering the bars entirely and filling the furnace. This method of burning is virtually smokeless. Cost of changes from the layout shown in the question to the one suggested here should be nominal.

*Portland, Oregon* F E BALDEN

## Pumps in Series

### *Answers to June Question 2*

#### *The Question*

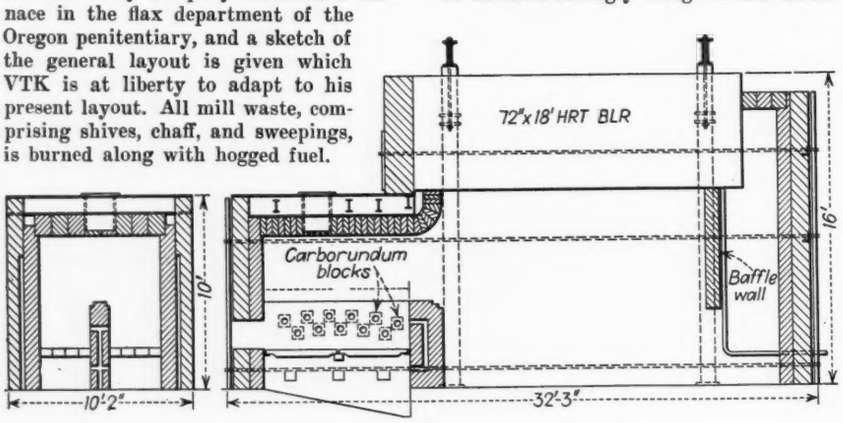
WE HAVE *two volute pumps, one single-stage developing 234 ft TDH at 1750 rpm and the other 2-stage developing 210 ft TDH at the same speed. Can these pumps be connected in series to get the combined head of both pumps, and if it can be done, which pump should be used as the first stage?*—WML

## Pointers on Connections

WLM'S PUMPS should work in series; best arrangement would be to use the single-stage pump as the suction unit, since the two-stage pump casing is likely to be more strongly designed and better adapted to stand full discharge pressure of the combined pumps. Piping connecting the pumps should be of ample size to reduce the inevitable small friction loss in the series connections. A check valve should be fitted on the outlet of the discharge pump, and priming connections should be fitted on both units, especially if it is necessary to use an ejector or other means to produce vacuum for priming. For pressure priming, air cocks should be fitted on the volutes of the discharge pump and also on the volute of the suction chambers of the single-stage pump. If undue leakage is experienced at the packing box of the discharge pump, breakdown rings with leakoff connections should be fitted to the packing boxes.

For satisfactory operation, head characteristics of both pumps should be as nearly similar as possible; that is, both should have either steep, medium or flat characterisites. Horsepower for the combined unit will be slightly higher than for the sum of the single units, due to series pipe losses, but the difference will be small.

*Seattle, Wash.* J Q OSBORNE




## Check Displacement

WHETHER or not the two pumps can be connected in series depends more on the displacement than on the TDH. It is obvious that if one pump has a considerable capacity in excess of the other, they cannot be connected in series; if capacities are nearly the same, they can be connected. The pump with slightly greater capacity should be first in the series. Slight excess capacity would thus prevent shortage of water at the second pump.

*Hartford, Conn.* H W BENTON

## Depends on Stuffing-Box Pressures

A MAJOR FACTOR in WLM's problem is the stuffing-box pressure that will exist in the pump used as the second unit, since it is well known that increased pressure makes proper packing more difficult. Likewise, increased pressure materially reduces life of packing and of shaft sleeves. In this case, it is necessary to determine which arrangement will produce the lowest pressure.

In single-stage pumps, both stuffing boxes are under suction pressure; in two-stage pumps, one is under suction pressure while the second is under discharge pressure of the first stage. To maintain a low pressure in the second box, some manufacturers use a close clearance between a pressure-reducing bushing and the shaft sleeve, leakage through this clearance flowing into an equalizing chamber ahead of the stuffing box. This chamber is connected to a similar one on the suction side. Theoretically, this is an adequate solution; unfortunately there is the possibility of wear of close-fitted parts bringing increased

(*Continued on page* 102)

# Because the new COPES

# FLOWMATIC

*has demonstrated*

—close boiler water level control on rapid load swings

—accurate feed flow control

—trouble-free operation

—low maintenance costs

more plants have selected it in its first year than had selected any other steam-flow type feed water regulator in its first two years. Now in service or on order for operating pressures from 130 to 1325 pounds.

**At 130 Pounds Gage:**
Holding practically constant boiler water level in spite of severe load fluctuations on a boiler fired by waste heat from an open hearth.

**At 400 Pounds Gage:**
Water level held within plus or minus 1½ inch on outdoor boiler installation carrying combined utility and sugar mill load, with capacity of 160,000 lbs. per hour.

**At 450 Pounds Gage:**
Utility perfectly satisfied with results from first installation. Orders two more Flowmatics for new 475-pound pressure boiler plant.

**At 850 Pounds Gage:**
Water level held within plus or minus 1½ inch on utility boiler carrying loads up to 400,000 pounds per hour. Another plant in same system orders Flowmatic for new boiler of same size and pressure.

Write for Bulletin 409-A

NORTHERN EQUIPMENT CO., 811 GROVE DRIVE, ERIE, PA.
*Feed Water Regulators, Pump Governors, Differential Valves*
*Liquid Level Controls, Reducing Valves and Desuperheaters*
BRANCH PLANTS IN CANADA, ENGLAND, FRANCE, GERMANY, AUSTRIA AND ITALY . . . . REPRESENTATIVES EVERYWHERE

*Get closer boiler water level control with the new*

COPES

FEEDS BOILER ACCORDING TO STEAM FLOW•AUTOMATICALLY

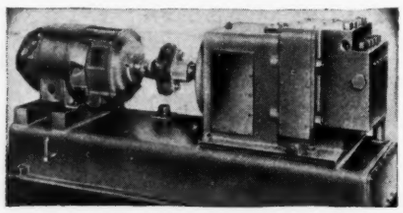
FLOWMATIC

★ REGULATOR

# What's New in Plant Equipment

## Hydraulic Pressure Pump

"UNIFLO" pump for operating hydraulic machinery is combination of "Squash-plate" operating mechanism with conventional packed plunger and poppet valves. Power unit is separate from hydraulic end and is fully enclosed. Hydraulic end is a single-piece steel forging drilled for plungers and valves. Arrangement of

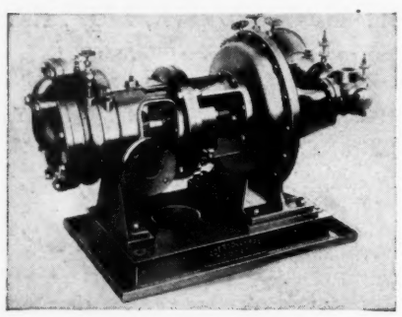


passages and valves permits use of plungers disposed in a circular fashion with transverse suction and discharge passage extending through block. Pumps up to 7½ hp have five plungers, larger sizes have seven. Piping may be attached to either side. Valves and bonnets are accessible without disturbing piping. Made in sizes from 2 to 100 hp for pressures of 1500 lb per sq in. and up.

*Watson-Stillman Co, Roselle, N. J.*

## Turbine-Driven Pump

COMBINES turbine and pump as one unit on common shaft. Built in single-stage sizes for capacities from 5 to 1000 gpm against heads as high as 220 ft, and in 2-stage sizes for capacities to 275 gpm and heads to 550 ft. A 15-hp unit is about 32 in. long and other sizes are proportionately small. For general in-

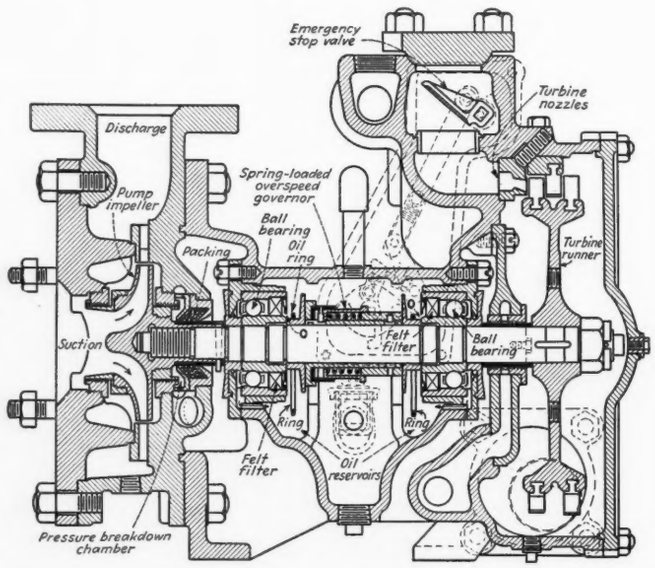


dustrial service where process steam may be utilized, as well as for boiler-feed service at pressures up to 200 lb per sq in. When steam is not available, turbines can be efficiently operated on compressed air. Bulletin 2390.

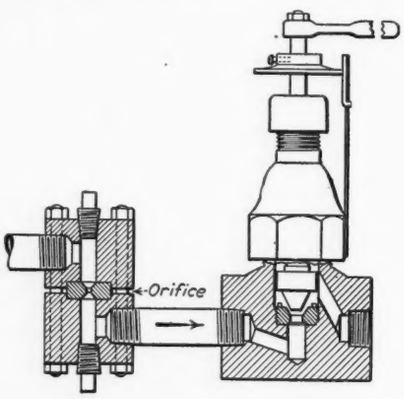
*Ingersoll-Rand Co, 11 Broadway, New York, N. Y.*

## Continuous Blowdown

CONTINUOUS blowdown assembly is based on an initial pressure drop ahead of a special steel blowdown valve. Pressure is reduced by a fixed "Anum-metal" ori-




fice that determines maximum flow. This results in a proportionate volume increase, due to reflash. Accuracy of control through blowdown valve is multiplied in




same ratio that volume has been increased. Further regulation is by special restricted seat and position indicator of blowdown valve. Standard valves furnished for pressures to 650 lb or temperatures to 800 F.

*Strong, Carlisle & Hammond Co, Cleveland, Ohio.*

## Welding Electrodes

THREE welding electrodes, Types W-20E, W-22E and W23-E, are intended for shielded arc welding of mild steel. W-20E is for general-purpose, single- or multiple-pass arc welding with ac or dc (straight polarity). W-22 is a fast-melting, smooth-flowing electrode with low spatter loss. Recommended for dc (reverse polarity). W-23E is a high-current or "hot" rod, so weld metal is quite fluid and washes up well on side walls of deep-groove joints and fillets. For ac or dc (reverse polarity).

*General Electric Co, Schenectady, N.Y.*

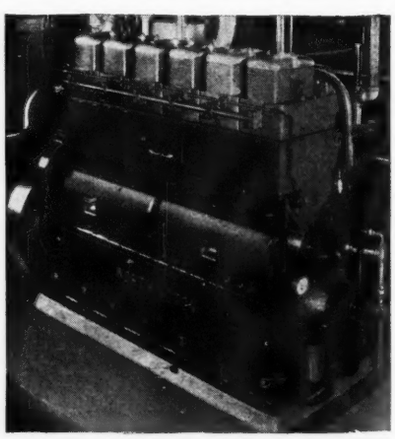
## Boiler-Feed Pump (above)

HIGH-PRESSURE, single-stage, centrifugal feed pump, for pressures up to 500 lb per sq in. and deliveries to 350 gpm, is powered by 2-velocity-stage steam turbine rated for 500 lb per sq in. and 700 F total temperature. Control is by overspeed trip governor, a spring-loaded assembly requiring no adjustment. Governor normally does not make any mechanical contact with trip lever connected to emergency valve; only at overspeed does governor engage trip lever. Hand trip and setting wheel permit tripping and resetting governor occasionally for testing. Pump operates at 7150 rpm, and because of high speed, pump and turbine form compact unit, largest unit size being 28 in. long, 21 in. high, and 20.25 in. wide.

*J S Coffin, Jr, Co, Englewood, N. J.*

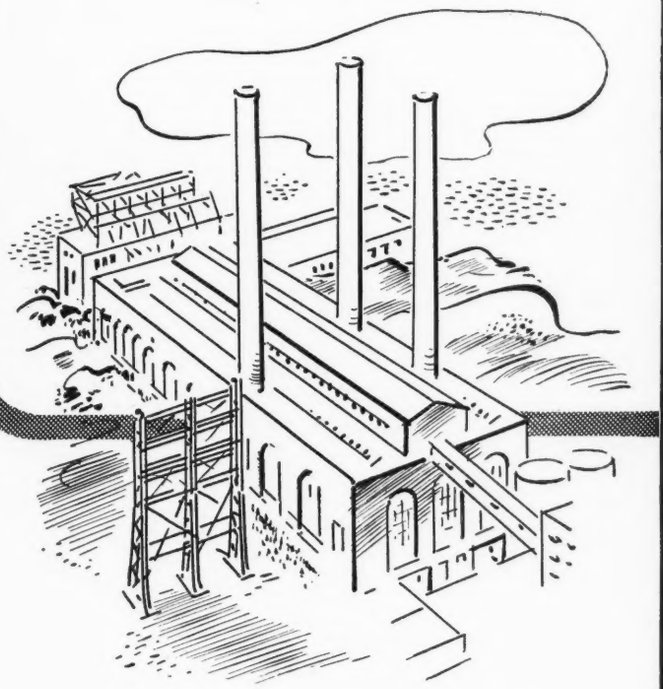
## Gas Engine

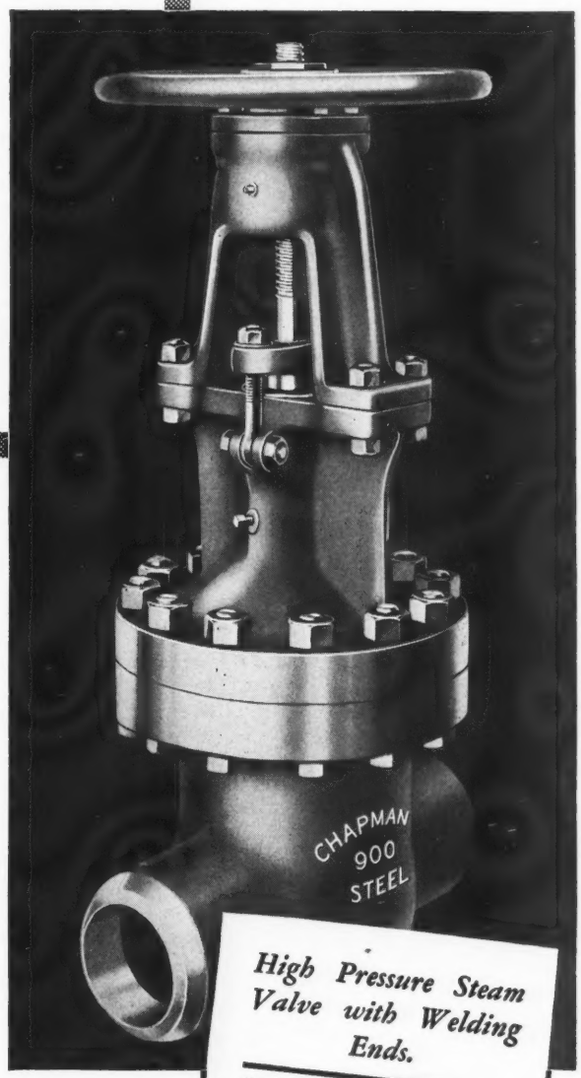
VERTICAL, 4-cycle, Type AG gas engine developed as heavy-duty, moderate-speed, small unit. Valve-in-head construction,



# Seven Special Steels

## *All types of operation*






*High Pressure Steam Valve with Welding Ends.*

There are many different power-plant valve problems . . . caused by temperature, pressure, corrosion and other operating conditions. And Chapman Valves meet these problems from one end of the plant to the other . . . meet them and keep them under control. For Chapman makes valves in the seven special steels listed at the right—alloys that are poured in our own foundries under the most exacting metallurgical control—castings that will stand up under temperatures as high as 1000°F., and pressures up to 1500 lb.

**CHAPMAN STEEL VALVES ARE MADE IN THESE ALLOYS**

Carbon Steel.
Carbon Molybdenum Steel.
Chrome Nickel Steel.
Nickel Steel.
Chrome Molybdenum Steel.
Chrome Tungsten Steel.
Chrome Nickel Tungsten Steel.

The Chapman Power Plant Line is complete . . . gate, globe, check and angle valves . . . with all types of operating mechanisms. And every valve is completely Chapman . . . machined by Chapman's master workmen from castings poured in Chapman's own foundries under precise metallurgical control. This *thorough breeding* means — to you — valve service and economy that are always definite "known quantities." *Write.*

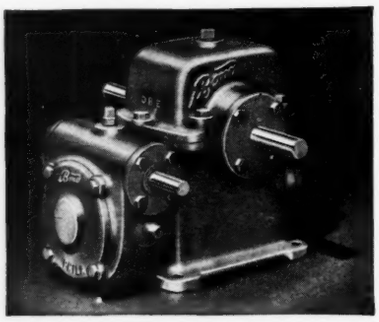
# CHAPMAN POWER PLANT VALVES

total enclosure of all moving parts, removable cylinder liners, separate water-cooled cylinder heads, lightweight oil-tight covers for crankcase accessibility, and force-feed lubrication. For electric generation, air- and gas-compressor drive, oil-field pumping, refrigeration and ice plants, irrigation, saw mills, and cotton gins. Bulletin S-550-B4C.

*Worthington Pump & Machinery Corp, Harrison, N. J.*

## Speed Reducers

TYPE B double-reduction speed reducers capable of handling inputs to 2 hp. Ratios as high as 4000 to 1 in both horizontal and vertical types. Worm gears of bronze and worms of hardened steel.



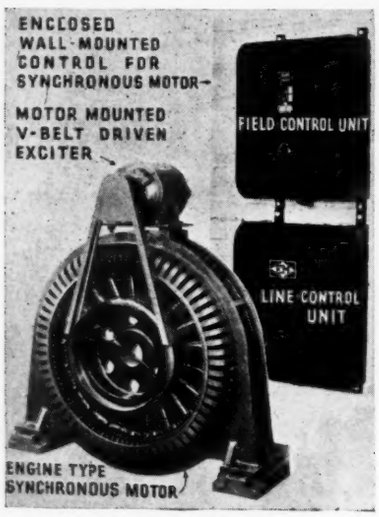
All shafts are mounted on bearings and oil seals are used on all shaft openings in housings.

*Charles Bond Co, 617 Arch St, Philadelphia, Pa.*

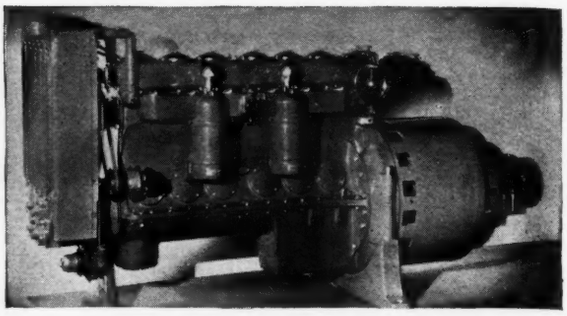
## Motor Equipment for Small Compressors

THIS equipment was developed to make direct-connected synchronous motors more practical and advantageous for smaller industrial reciprocating compressors down to 40 hp. Motor-mounted exciter eliminates need for floor space and extra wiring. Line control unit is magnetic, full voltage with overload and undervoltage protection. Field control unit is slip-frequency responsive type for automatically applying and removing motor field excitation.

*Electric Machinery Mfg Co, Minneapolis, Minn.*


ENCLOSED WALL-MOUNTED CONTROL FOR SYNCHRONOUS MOTOR
MOTOR MOUNTED V-BELT DRIVEN EXCITER
FIELD CONTROL UNIT
LINE CONTROL UNIT
ENGINE TYPE SYNCHRONOUS MOTOR

## Generator Sets

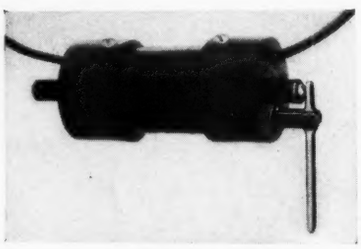


MADE in two sizes, one with 4-cyl engine delivering 45-55 kw, and the other with 6-cyl engine delivering 65-85 kw. Can be supplied complete with generator built into flywheel housing or separate and driven through flexible coupling. Engines are recently developed solid-injection units. Starting is on gasoline; simple handwheel permits switching over to diesel fuel. Each cylinder has independent injection unit mounted at center of cylinder head and driven by overhead camshafts. Fuel is filtered and supplied at low pressure; metering is by fuel injector.

*Murphy Diesel Co, Ltd, Milwaukee, Wis.*

## Electrical Contact

MOVEMENT required to open or close contact is $\frac{1}{64}$ in. where pressure is put directly against contact plunger. A pressure of 5 oz. is required, although contacts for lighter pressure can be made. Where lever is used, pressure required at lever end is approximately $1\frac{1}{2}$ oz.



While this contact is said to be particularly applicable to fractional hp and solenoid requirements, it will handle safely 30 amp at 110 volts or 15 amp at 220 volts ac. There are 12 silver buttons in the contact, each $\frac{1}{4}$ in. in diameter.

*Robert Hetherington & Son, Sharon Hill, Pa.*

## Spray Cleaners

MODELS J and K of "Hypressure Jenny" steam-vapor spray cleaners remove oil, dust, grease and dirt from motors, machinery, etc. Model J is a portable, automatic unit with electric ignition and nozzle control. Is instant starting, has pressure-atomizing fuel-oil burner with all accesories mounted in end panel. Operates at pressures up to 150 lb. Model K is stationary, continuous vapor-flow unit with manually ignited kerosene burner. Operates at pressures up to 110 lb.

*Homestead Valve Mfg. Co., Coraopolis, Pa.*

## Hand Tachometer

"UNIVERSAL" hand tachometer measures from 30 to 40,000 rpm with only three ranges. Operates on same centrifugal or flyball principal as Biddle Type C instrument, but has been redesigned to include ball bearings, knife-edge pointer, rotating gear shift and other refinements. Indicating dial is 3 in. in diameter. Instrument

supplied with carrying case and accessories. Made in two ratings: 30 to 40,000 rpm and 25 to 30,000 rpm.

*James G Biddle Co, 1211-13 Arch St, Philadelphia, Pa.*

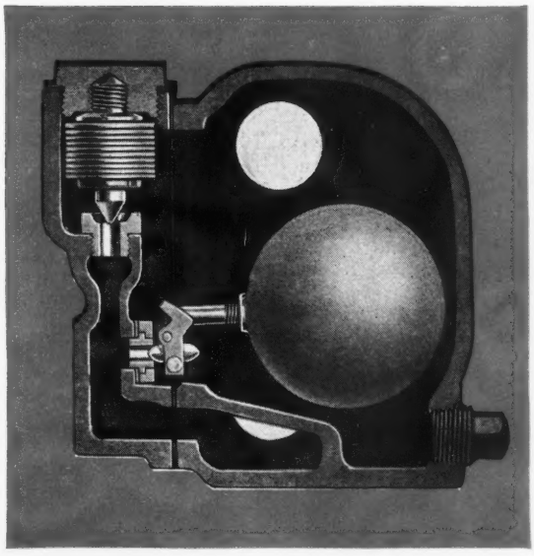
## Matching Machine for V-Belts

MULTIPLE V-belts vary slightly in length, which means that shorter belts will bear the brunt of the load, resulting in reduced efficiency and unequal belt life.

Recently developed automatic machine takes belt measurements while belts are running on pulleys under operating tension. Belt is placed over pulleys, which are then mechanically adjusted to provide normal tension. Before pulleys are put in operation, hand on dial registers.

# *Ask* YOUR HEATING PLANT TO SAY *a-a-a-h!*

## YOU MAY FIND IT *PHYSICALLY UNFIT* AND NEEDING A THOROUGH COURSE OF TREATMENT



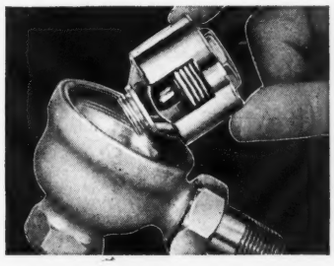
**50 SERIES HEAVY DUTY TRAPS**

Here is a trap which has caught the fancy of critical engineers—because it does a precision job under tough conditions. All working parts are mounted on the cover, easily removed without breaking pipe connections. Reversible Valve Pins and Seats add to its service life. Available either as a combination Float and Thermostatic Trap or Mechanical Trap. Capacities to 17,000 lbs. of water per hour.

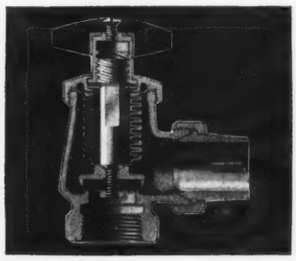
It doesn't take long, but what dividends a summer check-up of your heating plant can pay! Replacing time-worn equipment *now* will save a heavy toll in wasted fuel next winter.

For twenty-five years Hoffman Steam Specialties have enjoyed an enviable reputation with engineers who watch operating and maintenance costs with an eagle eye. Yet a premium price is not asked for the extra quality built into Hoffman Valves, Traps and Pumps. The line is complete—one source of supply—one responsibility.

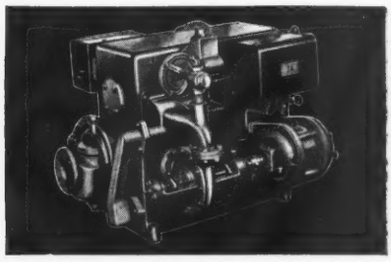
Examine any Hoffman Product. You can't help but be impressed with its sound design, its workmanship and its all-around excellence. Nor can you overlook performance records established in steam plants the country over. Write today for descriptive literature and engineering data.



**RADIATOR TRAPS**
A patented construction in Nos. 8A and 9A Hoffman Traps is the combined Thermal Member, Valve Pin and Seat, easily removed.



**SUPPLY VALVES**
A complete price range in packless supply valves for one and two-pipe steam systems, including adjustable modulating types.



**PUMPS**
Hoffman-Economy Vacuum and Condensation Pumps are known and specified for their simplicity of design and dependability. Types and capacities for all services.

*Guardian of Comfort and Fuel*

# HOFFMAN

**SPECIALTY COMPANY, INC.**

DEPT. P-8, WATERBURY, CONN.

*The Quality Line of HSCo Heating Specialties*

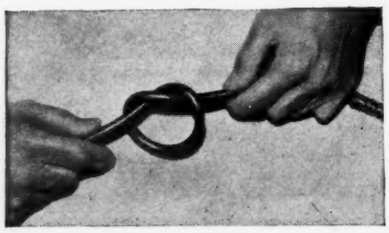
*Sold everywhere by Leading Wholesalers of Heating and Plumbing Equipment*

50, which represents nominal length of belt, but as soon as machine starts, dial will register less than 50 if belt is short and over if it is long. Each point it is under or above 50 represents 0.1 in.

*B F Goodrich Co, Akron, Ohio*

## Oil Tubing

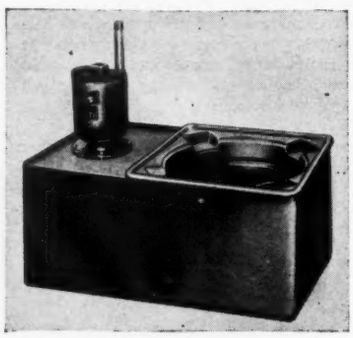
"RESISTOFLEX" PVA tubing for oils and solvents, made of flexible synthetic resin, is claimed completely insoluble in gasoline, oil, ethers, alcohols, etc. Physical characteristics include lightness (specific gravity of approximately 1.26), toughness, elasticity, and high flexibility. For fuel- and oil-handling equipment, conveying solvents and oils to chemical and process industries, hydraulic lines, etc.



*Resistoflex Corp, 370 Lexington Ave, New York, N. Y.*

## Coolant Tank and Pump Units

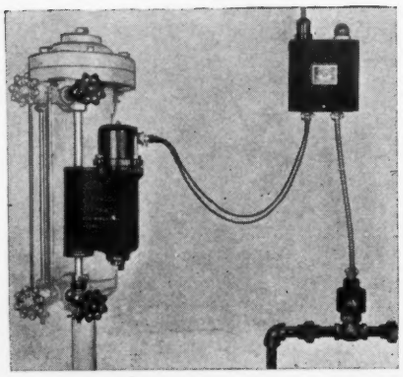
SERIES of self-contained coolant tank and pump units made in 5 sizes. Models 8H and 15H have Pioneer Model H pump mounted in compartment below tank bottom and cast-iron covers with built-in strainers. Models 26V, 35V and 50V have Model V pump mounted on stationary part of tank cover and pump is immersed in coolant. V models use either chip basket or bag filter. Capacities to 80 gpm and pressures to 53 ft of head.



*Pioneer Engrg & Mfg Co, 31 Melbourne Ave, Detroit, Mich.*

## Boiler-Water Control

IMPROVED automatic boiler-water control has redesigned electrode holder installed either in gage-glass tappings by "Y" fittings as illustrated or with equalizing pipe. This holder completes an electric circuit when boiler-water level falls below normal, water itself acting as a conductor between two electrodes and ground to operate electric feed valve or control a feed pump. A third electrode provides for a low-water cutout circuit.



*Johnson Corp, Three Rivers, Mich.*

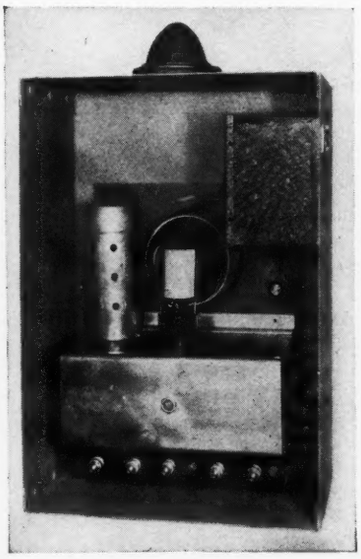
## U-Bolt Valve

BRONZE mounted and all-iron U-bolt valve has standard features of this type of valve plus several new developments, one of which is "bonnet-saver bushing". This makes it unnecessary to junk valve bonnet when operating threads are worn. By slipping a new bonnet-saver bushing into position, good-as-new thread engagement is obtained in same bonnet. Also, because this bushing can be lifted out, user can get into upper part of bonnet chamber to clean out any deposits.

*Jenkins Bros, 80 White St, New York, N. Y.*

## Counter Control Unit

PHOTOELECTRIC counter unit has light louvre system to cut off all extraneous light, and a corrected condensing lens to direct full light energy upon photo cell. Atop steel cabinet is amber light that signals each step of counter cylinder. $\frac{3}{4}$ in. separation of parts will serve to actuate counter, on 110 volts ac or dc. Hinged cover has provision for locking reset of counter.



*Wayne Automatic Relay Co, Fort Wayne, Ind.*

## Forged-Steel Valves

DROP-FORGED steel valves are now available with "Parkerized" bonnets, bonnet nuts, packing glands and packing nuts. Rust proofing process eliminates galling of threads due to atmospheric corrosion. Added improvement is identification disk held in place by handwheel nut. This disk records valve size, number, working pressure and temperature, and style of trim.

*Henry Vogt Machine Co, 10th & Ormsby Sts, Louisville, Ky.*

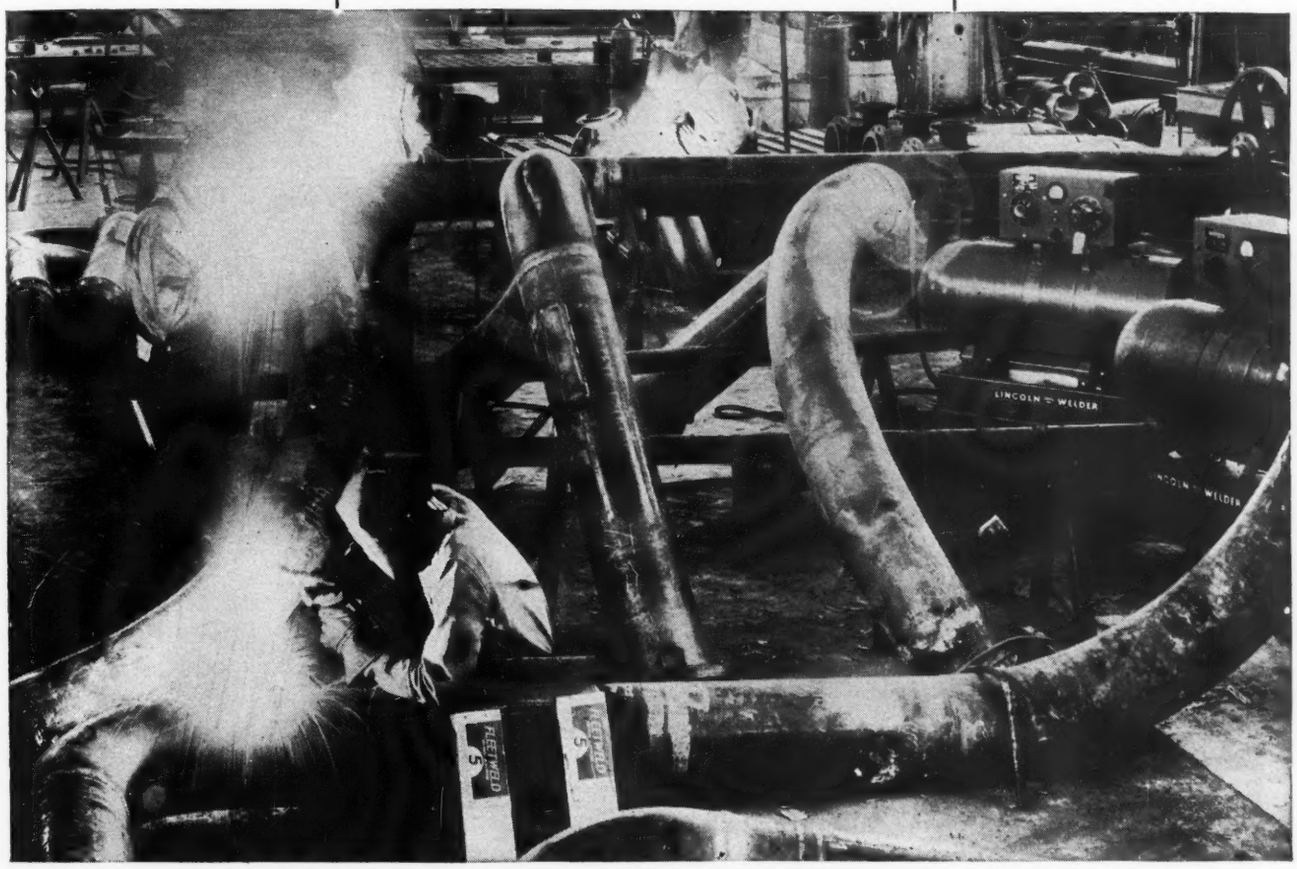
## Splash-Proof Motors

LINE of splash-proof motors of cast-iron construction has specially impregnated windings. Baffling system prevents entrance of water or falling particles; ventilation system assures low temperature

(*Continued on page* 108)

ADVERTISING PAGES REMOVED

*Lincoln* "Shield-Arc" *welding cuts pipe fabrication and erection costs as much as 20%. Here, Midwest Piping & Supply Co. Inc., St. Louis, Mo., fabricates piping for the Golden Gate Int'l Expo. with the world's favorite pipe welding combination—*"Shield-Arc" *Welders and "Fleetweld 5" Electrodes.*




# HOW LINCOLN USERS CUT COSTS

"We standardize on Lincoln for three mighty good reasons," says one shop superintendent.

"In the first place, Lincoln service cuts our welding costs. Since we've been welding, the Lincoln man has helped step up our production rate on some jobs 150% by showing us new techniques and ideas.

"In the second place, the Lincoln Welder best suits our variety of work. It is faster and its wide range gives us more welder for our money.

"In the third place, Lincoln 'Fleetweld' Electrode saves us more than $500.00 per year in welding costs. We discovered this by actual test."

Welding users the world over constantly cut costs with Lincoln equipment and service.

There are 60 Lincoln offices in the U. S., located in important industrial centers, and each one is staffed with skilled welding technicians. Call in a Lincoln man from the nearest office and judge for yourself whether he can cut *your* costs. No obligation. Mail the coupon.

LARGEST MANUFACTURERS OF ARC WELDING EQUIPMENT IN THE WORLD

LINCOLN

**THE LINCOLN ELECTRIC COMPANY**
**Dept. NN-513, Cleveland, Ohio**

I am interested in lower welding costs. ☐ Have the Lincoln man call, without obligation. ☐ Send free procedure guide (Bul. 401).

Name _____ Position _____

Company _____

Address _____

City _____ State _____

# Vice-President-Pup . . .

A FRIEND of mine used to tell this story of Sam Smull, who invited him up annually for a weekend's fishing. One year Sam had a big hound dog which he used to admonish regularly, "Now, Vice-President, you lie down and shut up!" It sounded funny, but my friend didn't say anything—after all a man's opinion of his dog is his own affair.

The next year, Sam had changed the order to "President, you lie down!" It finally got the best of my friend's curiosity, so he said, "Sam, where did you get that name for a dog? And how come he was 'Vice-President' last year, and now he is 'President'?"

"Easy", said Sam, "I gave him a promotion. Last year, he used to sit on his tail and growl all the time—now he just sits on his tail!"

That's the trouble with a title like vice-president, president—or sometimes chief engineer. Its bearer gets to thinking that he's arrived, and he begins to sit back and coast. He figures he's a success; he's gotten where he's going; now let somebody else do the leg work.

But you can't do that. You're either on the way up or the way down—you just can't stand still. Sure, your new boiler may have saved the company ten times your salary its first year, or that new pump may have cut the cost of water 10 per cent. But you got credit for that when somebody acknowledged it was a good job. In the minute that you got through with that successful job, you were a success. But right there the world raised the ante on you and said, 'Hmmm, this man looks to be worth watching! Let's see him do it again—and better."

Your plant may be all right, but keep plugging. See if you can't pinch another tenth or two off steam costs; see if a little preventive maintenance won't cut down your repair bills; figure out what you'll do with new equipment if somebody lets you get it; and keep suggesting that you need it. You've got to have the answer ready for any question that's raised on power—you're the ultimate authority in your own backyard, and if you don't know the answer, they'll have to go somewhere else to get it—which helps your credit not a bit.

Remember the Red Queen's remark in *Through the Looking Glass,* "It takes all the running you can do, to keep in the same place. If you want to get somewhere else, you must run at least twice as fast!"

George Edwards

*Engineer*

# *Long after this impeller*

# GAVE OUT..

*• Before and after — What happens to plain white cast iron impellers operating in pumps handling highly abrasive materials.*

# ..."NI-HARD"

# CARRIED ON!

***. . showed more than twice the life — handling a highly abrasive product***

Failure at the end of 551 hours was the average record of eight plain white cast iron impellers. Yet, operating under identical service conditions, six Ni-Hard* Nickel-Chromium Cast Iron impellers demonstrated an average life of 1319 hours. • These results were obtained from tests conducted at the Copper Cliff, Ontario, operations of the International Nickel Company. Here were the conditions: A highly abrasive product averaging 72% solid matter, handled by pumps having a vertical lift of 28 feet. As may be seen from the illustration, tests were continued until each set of castings was almost completely worn out. • Under such conditions as these you'll find it economical to use Ni-Hard, a durable alloy white iron. An extremely hard chilled or sand cast material, Ni-Hard cast iron usually contains 4.50% Nickel and 1.50% chromium. Consultation on the use of this and other Nickel cast iron compositions is invited.

*Reg. U. S. Pat. Off. Canadian patent number 281986.

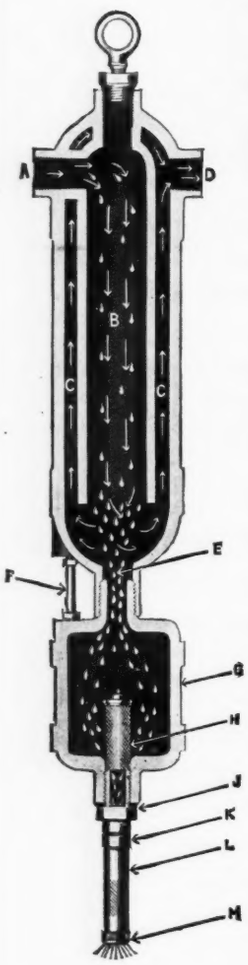
## NICKEL CAST IRONS

**THE INTERNATIONAL NICKEL COMPANY, INC., 67 WALL ST., NEW YORK, N. Y.**

# REMOVES WATER FROM COMPRESSED AIR LINES

Moisture in compressed air lines is especially troublesome now when relative humidity is high. Remove it with the

## SWENDEMAN AUTOMATIC SEPARATOR




It is not manually operated but entirely automatic—as the water precipitates it is immediately discharged.

This separator is made in styles and sizes to fit the applications. The size and style recommended is determined by the kind of service it is expected to do.

### *Exclusive Features of the Swendeman Separator*

The breaking of an otherwise air-bound condition by the use of a small and screen-protected vent which is open to the air at all times.

The ability of the Separator, by its correct principle of construction and by means of this vent, to expel all moisture automatically as fast as it accumulates.

The use of a separate chamber, which we designate as an eliminator, for the immediate removal of the moisture from the air-stream of the Separator, so that the air has no opportunity of picking it up again.

**(Also manufacturers of the Dexter Valve Reseating Machines for reseating globe valves, gate valves and pump valve seats.)**

THE LEAVITT MACHINE CO.

10 EAST RIVER ST. ORANGE, MASS.

Canadian Distributors:—

The Canadian Fairbanks-Morse Company Limited

15 Branches Throughout Canada


# Readers' Problems

(*Continued from page* 90)

leakage and pressure with the result that both stuffing boxes operate under high pressure. In this particular case, assume that stuffing-box pressures of the two-stage pump corresponds to the suction and first-stage discharge pressures respectively.

If the single-stage pump is placed first, both stuffing boxes will be under suction pressure, which can be assumed as zero. Discharge pressure will be 234 ft or 101 psi, and this will be the pressure under which the first box of the two-stage pump will operate. Pressure at the second will be 101 psi plus pressure generated by the first stage, 45 psi, making a total of 146 psi.

If the order of the pumps is reversed, stuffing boxes of the two-stage pump will be under 0 and 45 psi, while both boxes of the single-stage pump will be under 90 psi, the discharge pressure of the two-stage pump. Thus, the second arrangement would be better since a stuffing-box pressure of 146 psi is decidedly more severe than 90 psi. It is also logical to assume that the shaft diameter of the two-stage pump is the larger of the two, and so would have a higher rubbing speed at the packing, a factor which introduces further disadvantages in the first arrangement.

While the capacities of the pumps are not given, it is likely that for the same head and at the same speed, the single-stage pump is designed for a somewhat higher capacity, assuming that both impellers are designed for the same range of specific speeds. If this is so, the single-stage pump will develop more than 234 ft TDH at the capacity at which the two-stage pump develops 210 ft. Thus, if the latter pump were the second in the series, its stuffing-box pressures might become much higher than 101 and 146 psi, respectively. Just how much higher would depend on the characteristics of the pumps.

While stuffing-box pressure is probably most important, it would be well to check the maximum permissible casing pressure. It should not be hard to obtain this information from the manufacturer. However, the final discharge pressure is only 191 psi and either pump is probably siutable for this.

*Harrison, N. J.* I J KARASSIK

## Need to Know Head-Capacity Curves

WLM HAS NOT given complete information on his pumps. The head-capacity curves must be known before a satisfactory answer can be given. In Fig. 1, curves are given for two pumps of the same capacity, and the heads of the pumps are added to give the result if pumps are combined in series. If the sum of the static, friction, and velocity heads to be overcome is given by curve *AB*, the pumps will operate at *B*, with

# the Case of THE THOUGHTFUL PROFESSOR

Not long ago, Scovill asked a faculty member of a leading university — a famous man in his field — to prepare two sections of Scovill's Heat Exchanger Tube Manual. His 22 pages on Fluid Flow & Heat Transfer are some of the most brilliantly executed in the book. And like the rest of this work, the professor's thoughtful, thought-provoking sections are complete with tables, charts, equations, nomenclature, bibliographies.

As well as to him, Scovill also owes a debt of gratitude to engineers (perhaps you among them) for help given us directly and indirectly in compiling the book. We use it now as source data to solve problems on which Scovill representatives work with you.

Scovill men visit Scovill customers frequently — arranging visits to coincide with inspection and overhaul periods or retubing when possible. These men seek to function as consultants on subjects relating to tube service. They invite discussions aimed to solve your difficulties.

We believe sincerely in this method of doing business, as sincerely as we believe in the uniformly high quality of tubes produced by our laboratory-controlled processes of manufacture: either extruded, hot pierced, or cup drawn.

We believe that this kind of Engineering in production — added to Scovill's Engineering data, and Scovill's Engineering service — helps, make for longer, more efficient tube life.

Please write for the booklet *Scovill Condenser Tubes*, containing suggestions on installation methods and other informative notes. Address Scovill Manufacturing Company, 13 Mill Street, Waterbury.

A far-seeing manufacturer of condensing equipment experienced difficulty in obtaining satisfactory tube life in his vent condensers. Scovill proposed a different tube material, the physical properties and laboratory tests of which promised superior performance in this service. Trials demonstrated the soundness of this suggestion and although the first cost is somewhat higher, the manufacturer has standardized on this tube alloy for all his vent condensers.

SCOVILL
Masters of Metal

## Scovill Condenser Tubes

**one product . . . three services**

*For ACCURATE Measurement*

**SIMPLEX**

**VENTURI TYPE**

**METERS**

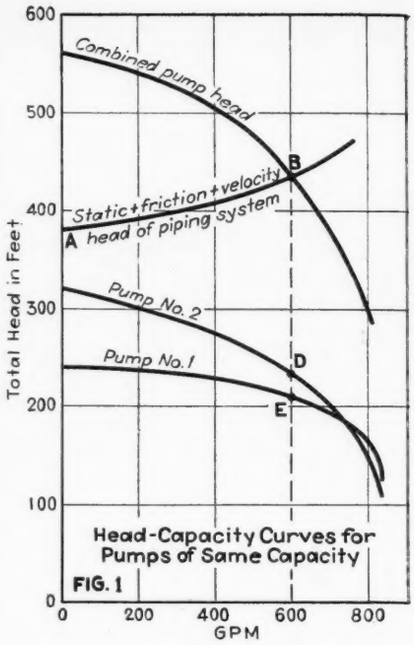
*Simplex, type MO, Meter Register*

- **Economical plant operation demands the keeping of reliable flow records of all plant functions. SIMPLEX VENTURI TYPE METER REGISTERS provide an accurate, sensitive means of obtaining such records.**
- **Sturdy in design, built for wide range service, Simplex Meters are selected by the discerning engineer for boiler feed, steam, condensate or evaporate flow measurement.**
- **Simplex Meters can be furnished in any size and for operation under working pressures up to 2500 pounds.**
- **Let Simplex Engineers help you with your metering problems.**

***Write for Bulletin 42-A***

**SIMPLEX VALVE AND METER COMPANY**

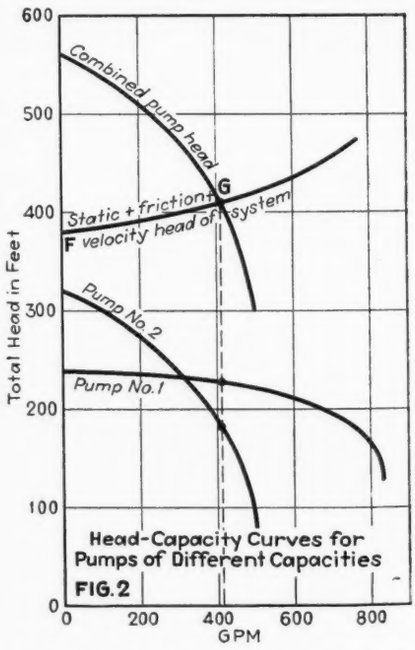
**6780 Upland Street** **Philadelphia, Pa.**




Pump No. 1 producing the head at *E*, and Pump No. 2 that at *D*.

Now assume that Pump No. 2 has only one-half the capacity of No. 1, and the head curves are as shown in Fig. 2. If the pumps are in series they will now operate at a different discharge and a different head, point *G*.

Centrifugal pumps are designed to fit special conditions and when they are put

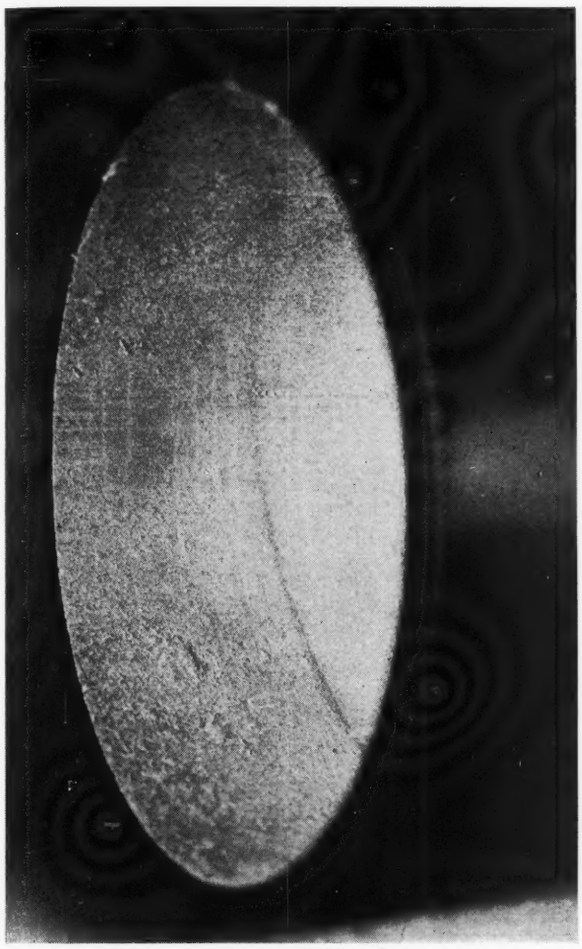



in the wrong place they will not give satisfactory service. WLM should check the conditions under which his pumps will operate and should also check the combined head-capacity curves, to see if he is going to get the head he wants.

*Clemson, S. C.* J H SAMS

## Put Single-Stage Pumps in Series

THE TWO volute pumps can be connected in series and I would advise using the



*Interior surface of new tube prepared for coating with APEXIOR*

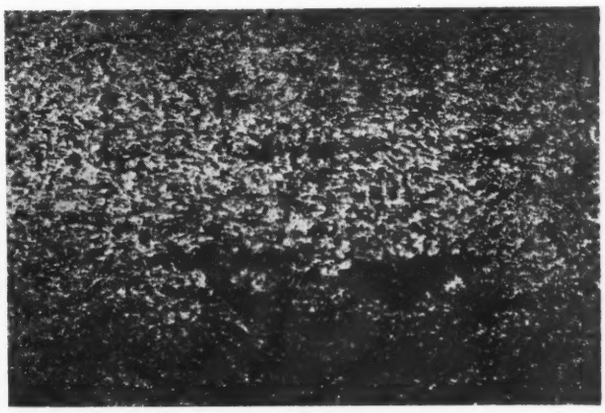
# *PLUG the RAT HOLES*

APEXIOR NUMBER 1 fills and seals capillary spaces and any porous or open surface of boiler tube and drum steel. Penetration of boiler water is prevented at joints of tubes, plates, or rivets. APEXIOR forms a mechanical barrier between boiler water and boiler metal.

**WATER DAMAGE CANNOT OCCUR WHERE WATER CONTACT IS PREVENTED**

This is a vitally important service in areas of stress concentration. Over all other areas in any boiler, APEXIOR protective coating is the accepted and standard means for improving the quality of evaporating surfaces, reducing scale adherence, and for increasing the resistance to corrosion.

APEXIOR NUMBER 1 is the accepted protective coating for the interior of steam boilers and steam turbines, approved in all industrial, utility, marine and railroad boiler operation. Brush applied .0025″ thick to clean metal when boiler is out of service. Supervision available anywhere in the United States. Special brush equipment for handling the inside of water tubes or the outside of tubes to be installed in fire tube or locomotive type units. Boiler metal maintenance problems gladly discussed. Ask for Bulletin 1300.



*9X Magnification — Steel Boiler Tube, as received from mill, showing vulnerable open condition of the surface.*

APEXIOR
REG. U.S. PAT. OFF.

## THE DAMPNEY COMPANY OF AMERICA

HYDE PARK • BOSTON • MASSACHUSETTS

Atlanta Chicago Detroit New York Philadelphia

**ENGINEERING SALES REPRESENTATIVES** — Pittsburgh, San Francisco, Los Angeles, Portland, Seattle, Phoenix, Denver, Salt Lake City, Dallas, Vancouver, B. C., Montreal, P.Q., Havana, Cuba, Manila, P.I., Honolulu, T.H., Marine Dept., 114 Liberty St., New York, N.Y.

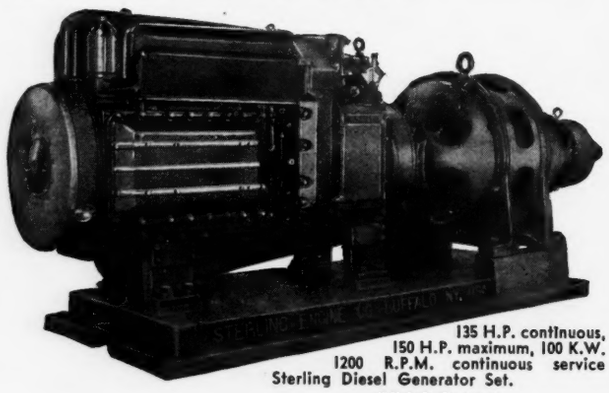
# THE STERLING DIESEL ENGINE

**achieves natural turbulence without using pre-combustion chambers or cylinder heads or valves**

Best atomization of fuel is secured with high efficiency. Ample air intake and exhaust ports scavenge the cylinder completely. Pistons act also as valves, eliminating many parts.

**STERLING HIGH DUTY**

**INTERNAL COMBUSTION ENGINES**



135 H.P. continuous, 150 H.P. maximum, 100 K.W. 1200 R.P.M. continuous service Sterling Diesel Generator Set.

(Michell Patents)

If you contemplate a diesel installation, investigate the possibilities of direct connecting the Sterling engines to pump or generator. Save tremendously in first cost and in fixed charges.

GAS • GASOLINE • DIESEL • ENGINES

**STERLING ENGINE COMPANY**

Home Office and Plant, 1270 Niagara Street, Buffalo, New York.

Dept. C-1

Branch Office, 900 Chrysler Bldg., New York, N. Y.



DIESELS • RECIPROCATING ENGINES • PUMPS • CONVEYORS • GENERATORS • STOKERS • ASH-HANDLING EQUIPMENT

**These, and many other types of power plant equipment that shake and jar, need the protection of**

**UNSHAKO**

**The Nut that can't shake loose**

**They are the SURE means of keeping equipment tight**

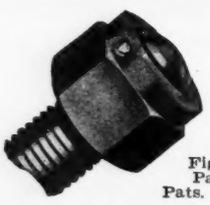


Fig. 1513 Pat'd. & Pats. Pending

The "live-acting", built-in locking ring is always ready to frustrate vibration's efforts to dislodge the "Unshako" Self-Locking Nut. The nut is one piece, easy to install and easy to take-off, provided a wrench is applied. It cannot harm the bolt threads so can be re-used over and over. Write for particulars of this different type of lock nut.

**STANDARD PRESSED STEEL CO.**

BRANCHES: BOSTON, DETROIT, INDIANAPOLIS

JENKINTOWN, PENNA. Box 577

BRANCHES: CHICAGO, ST. LOUIS, SAN FRANCISCO


single-stage pump as the first stage, since the 2-stage pump, being much smaller in diameter, would more than likely have a lower unit stress in the casing. I don't believe that there would be enough difference in operating efficiency to consider that angle in deciding sequence of pumps.

*Pasadena, Texas* A W ALLISON

## Engineers' Books

(*Continued from page* 76)

how graphic instruments can be used. Chapters three to seven cover the problems of power, such as generation, transmission, distribution, sale, purchase and use. The problems of the machine receive attention in chapters eight to eleven, and include design, selection, operation, maintenance and safety. Then follow two chapters on development, improvement, inspection and control of processes. Problems of men, such as measuring production work, scheduling performance and determining costs are in three chapters. Chapters seventeen to nineteen cover such problems as inspection, testing, demonstration, sales, research, etc.

### Photoelectric Devices

PHOTOELEMENTS AND THEIR APPLICATION (1938)—*By Dr. Bruno Lange, consulting engineer, Berlin, Germany. Translated into English by Ancel St. John, PhD. Published by Reinhold Publishing Corp, 330 West 42nd St, New York, N. Y. 297 pages, 6x9 in., 167 illustrations, cloth covers. Price $5.50.*

Light sensitive elements, better known as electric eyes, although comparatively new in their present commercial forms, have already been applied in practically every industry. The author, who is the inventor of widely used types of photoelectric equipment and who has devoted a lifetime of study to the subject, has given in this book a clear outline of the basic electric phenomena and historical development of photoelements, their physical properties and a detailed discussion of the many possibilities of applying them for scientific and industrial purposes.

In the first part of the book, historical development, theories concerning semiconductor photoeffect, and physical properties of semiconductor photocells are considered. Part two covers the construction and performance of photoelements, and applications of these devices in illumination meters, colorimeters, visibility meters, current meters and pyrometers, switching and signaling devices, relays, smoke indicators, generator protection, etc.

The material is presented in a practical and easily read form, so much so, that a large part of it can be grasped by those with a rather limited technical training. The book, having been written in Germany, represents practice in that country, but it contains much that is helpful to everyone interested in the electric eye and its many applications.

Railroads are exacting buyers of boilers. They insist on units with demonstrated ability to deliver low-cost steam under varying load conditions.

These two Edge Moor Boilers are of the three-drum bent-tube type, each 515 hp., for 225 lb. operation and producing 35,000 lb. of steam per hour with pulverized fuel. These boilers have front and rear walls.

We build in our own shops the complete boilers with welded drums; superheaters; water walls; air preheaters; economizers. Under one contract and one responsibility we furnish and erect complete plants including firing equipment, furnaces, soot blowers, fans, etc.

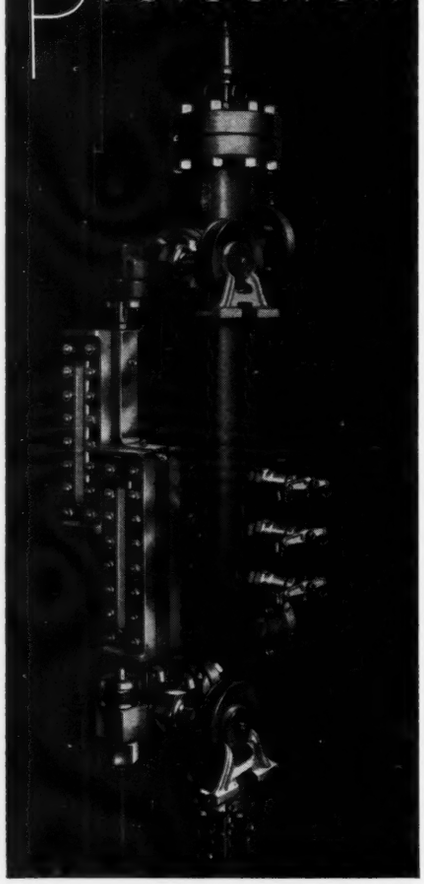
FOR FURTHER INFORMATION
SEE OUR CATALOG IN SWEET'S

*Above: Partial side view of Edge Moor boiler tubes and front water walls in place of Missouri Pacific plant. Below: Showing all tubes in place, also front and rear walls.*

EDGE MOOR IRON WORKS INC. • 30 Rockefeller Plaza, New York

# EDGE MOOR Water Tube BOILERS

POSITIVE
Protection



Yarway's unique Hi-Lo Alarm mechanism utilizes balanced *solid weights* that are as indestructible and unchanging as the metal itself. Operating on the displacement principle, they literally "weigh the water level."

When the high or low water emergency occurs—instant, positive, powerful, hair-trigger *action* results—giving warning of danger by whistle, light, or both.

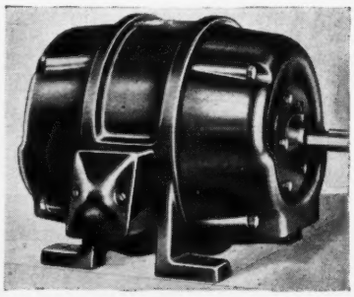
*Yarway Water Columns, eight standard models, iron bodies with screwed connections for pressures up to 250 lbs., forged steel bodies with flanged connections for pressures up to 1500 lbs., are fully described in Catalog WG-1806. Write for a copy and working model.*

**YARNALL-WARING COMPANY**
100 Mermaid Ave. Philadelphia

YARWAY
FLOATLESS HI-LO ALARM
WATER COLUMN

# New Equipment

(*Continued from page 96*)



rise. Sealed ball bearings are accessible for lubrication in all mounting positions. Line conforms to NEMA specifications.
*Diehl Mfg Co, Elizabethport, N. J.*

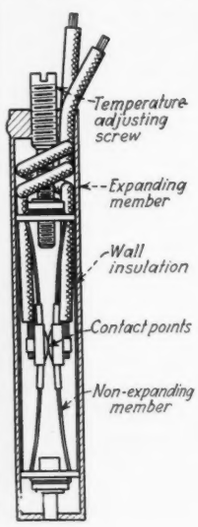
## Voltage Regulator

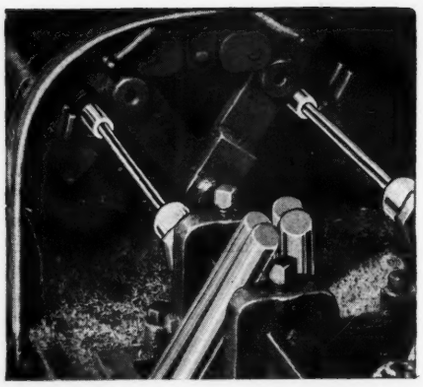
"SILVERSTAT" regulator for automatic voltage control of small ac and dc generators is of direct and quick-acting, rheostatic type, and regulates voltage by varying directly resistance in field cir-

cuit. Few moving parts are permanently supported by leaf springs; no pivots or similar bearings to wear and work loose.
*Westinghouse Elec & Mfg Co, E Pittsburgh, Pa.*

## Cartridge Switch

THERMOSWITCH has adjustable operating range of 0 to 400 F. Outer shell is thermo responsive element. Parts which carry contacts are thermally inert and arranged so that contacts are pressed firmly together while closed. As contacts are sealed within shell, several breaks decrease oxygen tension to eliminate further oxidation, and tendency of arcing in remaining inert gas is nil. Current rating, 10 amp. 110 volts ac.
*Fenwal Inc, Ashland, Mass.*



All LONERGAN steel gauge tubes are made from a solid tool steel bar to insure accurate resiliency and long life.

THE LONERGAN
"WATCHWORD" IS
PRECISION

Solid tool steel is accurately drilled and tooled to within 2/1000 of an inch of the specified standard in making tubing for models "HRG," "LRG" and "GH" LONERGAN Gauges. All LONERGAN Gauges are triple-tested to within 1% of absolute accuracy. This precision in manufacture with only the highest grade materials has made LONERGAN Gauges "standard equipment" wherever the best gauges are required.

For replacements or new equipment see your local distributor or write us direct.

MODEL
HRG
HIGH
PRESSURE
GAUGES

Designed with practically test gauge accuracy in commercial installations and especially adapted to heavy-duty service and all high pressures, where accuracy and life of the gauge are paramount.

J. E. LONERGAN CO.
SECOND & RACE STS., PHILADELPHIA, PA.
*300 Specialties for Power Plants*
Standard Since 1872

Lonergan
VALVES · GAUGES
· SPECIALTIES ·

# *There's no substitute for* SAFE *power plant piping*

# USE NATIONAL SEAMLESS

IN power plant piping, it's an established fact that the safest pipe is the best investment.

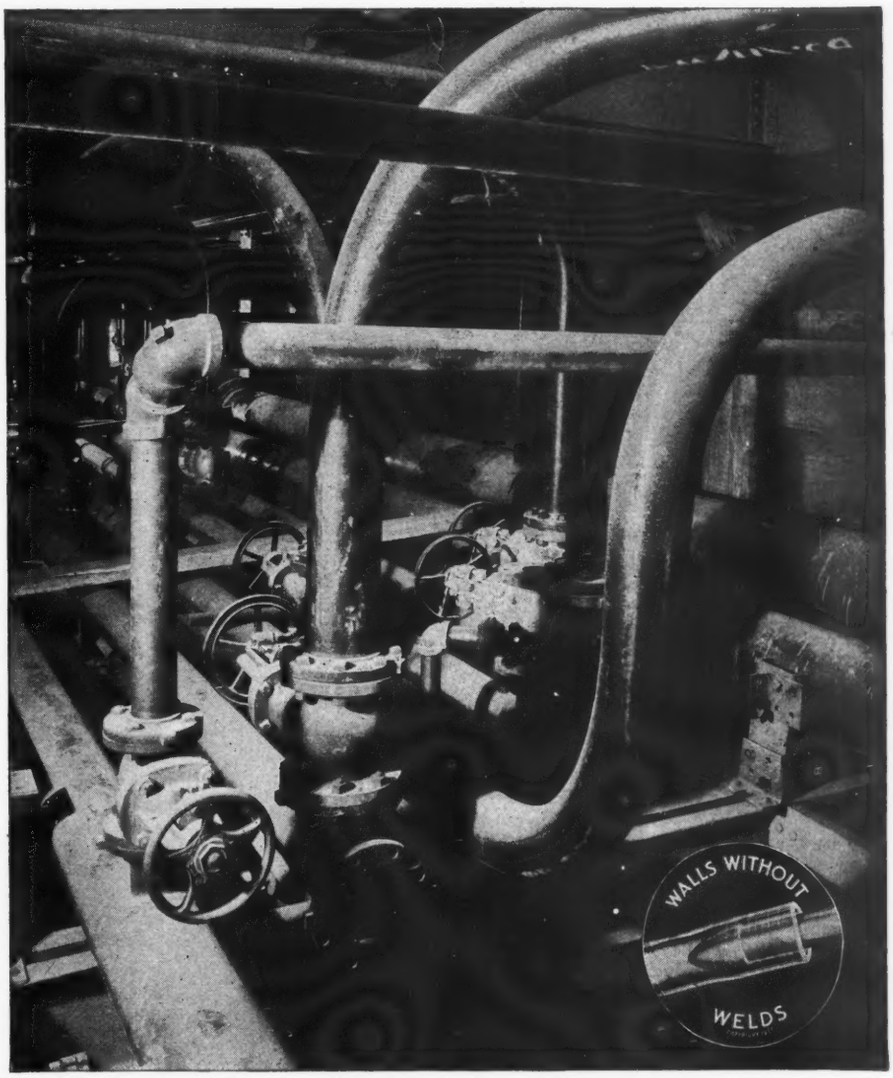
That's why leading power plant engineers prefer to work with NATIONAL Seamless—the pipe that is made without a weld, with no line of potential weakness.

These men tell us that NATIONAL Seamless cannot be excelled in high pressure steam service . . . that it stands up satisfactorily under expansion, contraction, vibration, due to pressure and all other rigorous conditions in power plant operation. They appreciate its ready workability, too . . . they can weld it with ease, bend and flange it without injury, and readily adapt it to any type of joint.

In reaching these conclusions, power plant engineers are confirming the results of our own laboratory tests, for the job of testing NATIONAL Seamless Pipe is one that never ends.

Every raw material that goes into the production of NATIONAL Seamless must first meet rigid specifications. Billets of steel, sound and flawless in every respect, are used for piercing, as any defect in the metal will be disclosed in this process. Every finished length of this pipe must pass through final tests and inspections, including the hydrostatic test, in which it is subject to pressures far in excess of actual working pressures.

No wonder power plant engineers have confidence in NATIONAL Seamless Pipe. For it is METALLURGY'S NEAREST APPROACH TO THE PERFECT PIPE! Write for complete details.




**THE SMOOTH SURFACE** *of* NATIONAL *Seamless Pipe, with the absence of any welding ridge, is ideal for the application of insulating materials.*

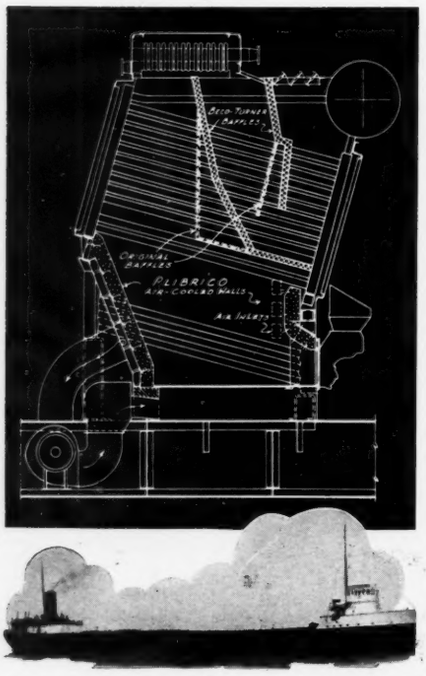
## NATIONAL TUBE COMPANY

PITTSBURGH, PA.

Columbia Steel Company, San Francisco, *Pacific Coast Distributors* — United States Steel Products Company, New York, *Export Distributors*

UNITED STATES STEEL

# SAVING 20%




## Beco-Turner Baffles Cut Fuel Consumption

LAST WINTER, three 250 hp. marine-type boilers on the *S. S. William A. Reiss* were provided with Beco-Turner baffles and Plibrico air-cooled walls. The print above shows the improvement in baffle design which was made by our engineering department. As a result of the improved baffles and setting, coal consumption has been reduced from 488 lbs to 381 lbs. per mile—a saving of 107 lbs. of coal per mile, or over 20%.

Beco-Turner baffles save fuel because (1) they are absolutely gas-tight, due to their ingenious expansion joints which prevent cracking, and because (2) every installation is engineered to bring about the most effective heat transfer to the boiler.

Our engineering department will gladly give you any possible recommendations for improving the performance of your boilers through more advanced baffle and furnace design. Send blueprints for our recommendations, or use coupon to request new catalog, "Plibrico Boiler Setting Construction for Water Tube Boilers," which covers Beco-Turner baffles in detail.

**Plibrico Jointless Firebrick Co.**

*Nation-Wide Boiler Setting Service*

**BAFFLE DEPT. CHICAGO, ILL.**

**MAIL COUPON FOR FREE CATALOG**

**Plibrico Jointless Firebrick Co.**
**1818 Kingsbury St., Chicago, Ill.**

P8-38

Mail copy of "Plibrico Boiler Setting Construction for Water Tube Boilers" covering Beco-Turner baffles.

Firm .....

Address .....

.....

Name ..... Title .....

Send blueprints for baffle recommendations


# STRAWS

(Continued from page 80)

forced and induced draft fans, soot blowers. $375,000 has been authorized for this and other improvements in station.

**COLORADO**——State Executive Council, Denver, plans steam-electric plant for light, power and central heating service for Statehouse and neighboring state buildings, with underground lines for all services. Cost about $700,000. Financing through Federal aid. James Merrick, Statehouse, supt. of state buildings, in charge.

**CONNECTICUT**——Dept of Justice plans boiler house at new multi-unit Federal prison at Danbury. $1,750,000 authorized for project.

Regional District High School Board, North Canaan, Samuel Eddy, chairman, plans central heating plant in multi-story senior high school near Falls Village. Cost about $350,000. Financing through Federal aid. Ernest Sibley, Litchfield, architect.

State Dept of Public Works, State Office Bldg, Hartford, will build power plant at new state school for mental defectives at Southbury. Cost $5,726,000, of which $2,576,000 will be a Federal grant.

Construction Service, Veterans' Administration, plans power plant at new veterans' institution at Rocky Hill. Fund of $1,462,000 has been authorized for project. Proposed to ask bids soon.

Bridgeport Housing Authority, City Hall, Bridgeport, plans central-heating plant at new housing development and slum clearance project in East Bridgeport. Cost about $6,500,000. Work scheduled to begin soon. Financing through Federal aid.

**FLORIDA**——Water Bureau, Miami, plans diesel-electric generating plant for municipal water-pumping station at Hialeah, comprising two 700-kw diesel units and auxiliary equipment. Cost about $200,000. Bids will be asked soon. Carl F Lambert, Biscayne Bldg, Miami, consulting engineer.

Homestead plans improvements in municipal electric plant, including 700-kw diesel-generator unit and auxiliary equipment. Financing through Federal aid. William Sydow, 3461 Main Highway, Miami, consulting engineer.

Florida Coast Seafood Corp, Apalachicola, plans 1-story refrigerating and quick-freezing plant on waterfront. Costs about $45,000, with equipment. Several other similar plants are planned at other points along coast. H. E. Goodenow, general manager.

**GEORGIA**——Troup County Board of Commissioners, LaGrange, plans central-heating plant for county courthouse, jail and office building. Cost about $235,000. Financing through Federal aid. William J J Chase, 140 Peachtree St. N E, Atlanta, architect.

Dept of Agriculture, Atlanta, Columbus Roberts, commissioner, plans power house in connection with new state farmers' market building. Cost about $1,000,000. Financing through Federal aid. T Firth Lockwood, Murrah Bldg, Columbus, architect.

Augusta, plans central-heating plant in municipal auditorium. Cost about $275,000 Financing through Federal aid. Scroggs & Ewing, SFC Bldg, Augusta, architects.

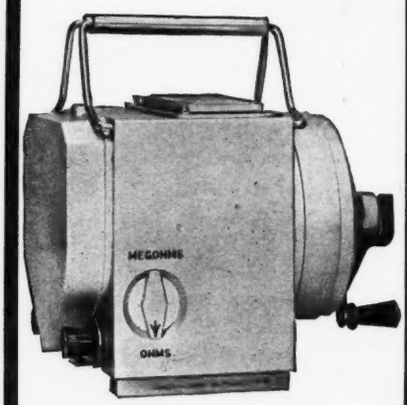
Capital Square Improvement Commission, Atlanta, B E Thrasher, secretary, plans central-heating plant in 4-story U-shaped state office building, Capitol Square, S E. Cost about $500,000. Bids will be asked soon. Financing through Federal aid. Constantine & Bradbury, William Oliver Bldg, Atlanta, architects.

Board of Colquitt County Commissioners, Moultrie, plans central-heating plant for local courthouse and jail building. Cost about $250,000. Financing through Federal aid. T Firth Lockwood, Murrah Bldg, Columbus, architect.

Rome plans motor-driven pumping machinery and auxiliary equipment, water-treatment plant, water-storage tanks, etc for municipal waterworks. Cost about $447,000. Work will begin soon. Robert & Co, Bona Allen Bldg, Atlanta, consulting engineers.

**ILLINOIS**——Board of Education, Rock-


# "Worth Its Weight in Gold!"




"Super-Meg" Insulation Tester

## "Megger" Tester saved $2500 on a single rewinding job.

Harry Mc——* operates a 975-kva hydro plant which furnishes power to a city in Virginia. One day while making a periodic "Megger" test on one of his 300-kw. machines, he noticed that the insulation resistance had dropped from over 100 megohms to about 30. A month later the "Megger" test showed 6 megohms—still good insulation, to be sure, but a clear indication that something was wrong.

An examination of the generator revealed a defective coil which was replaced—without burnout, without any interruption to service, and without rewinding the whole machine—a clear saving estimated at not less than $2,500.

In Mr. Mc——'s own words:—"I think this one instance is enough to show that your 'Megger' is 'worth its weight in gold.' I wouldn't part with it for any price, if another could not be had."

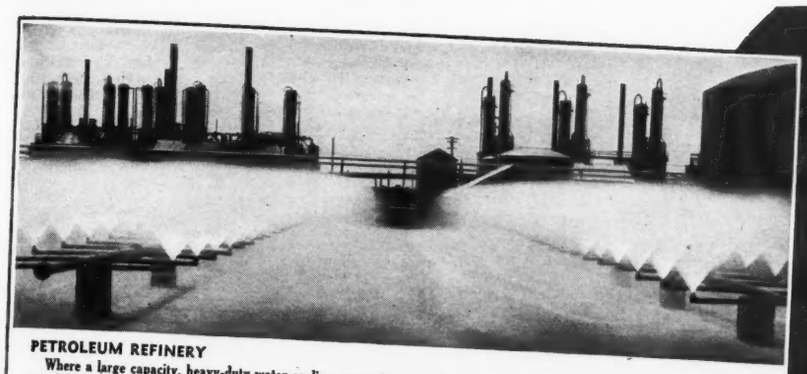
*A "Megger" instrument is good insurance! What is it costing you to be without one? Write for descriptive "Megger" Catalog 1550-PH.*

**JAMES G. BIDDLE CO.**

ELECTRICAL INSTRUMENTS

1211-13 ARCH STREET PHILADELPHIA, PA.

*Name and address on request

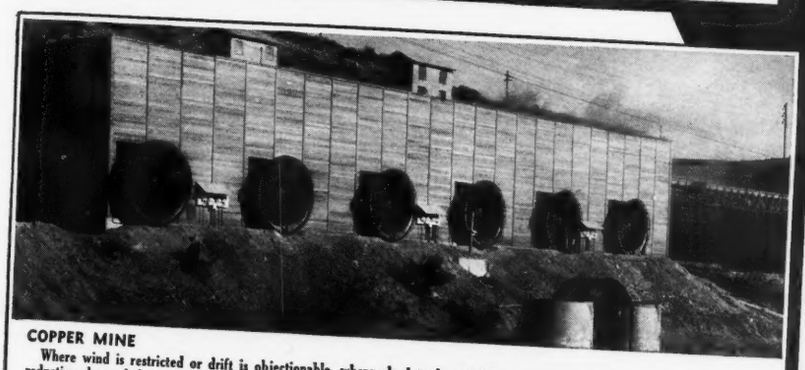


PETROLEUM REFINERY

Where a large capacity, heavy-duty water cooling system is required and an open area available, a spray pond is often recommended. Marley Spray Ponds are famed for higher efficiency and lower operating cost.

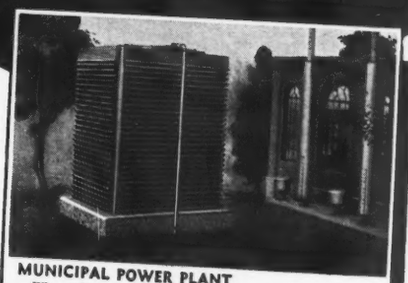
# EFFICIENT, ECONOMICAL Water Cooling

## whatever your needs may be



COPPER MINE

Where wind is restricted or drift is objectionable, where absolute dependability is necessary at all times and a heavy heat-reduction demanded together with extreme flexibility of control to meet varying operating loads and seasonal weather changes, Marley Forced-Draft Towers are giving valued service.



MUNICIPAL POWER PLANT

Where it's a problem of jacket water cooling, either open or closed system, Marley Spray and Spray-Coil Towers provide the proper solution.

# MARLEY *Individually Engineered* Cooling Equipment

## Serves These Plants and Thousands of Others in Widely Diversified Industries

Meeting the complex and exacting requirements of plants large and small in hundreds of different production activities has given MARLEY engineers broad experience. The completeness of the MARLEY standard line plus thousands of special developments enable them to design for each plant precisely the equipment to perform every desired function with the utmost efficiency and economy.

The conservation of water in industry by means of evaporative cooling has proved increasingly profitable over many years. The tremendous growth of The MARLEY Company through those years is the result of building products which render BETTER service to industry. Each new installation adds further evidence that MARLEY equipment is an investment which returns large dividends.

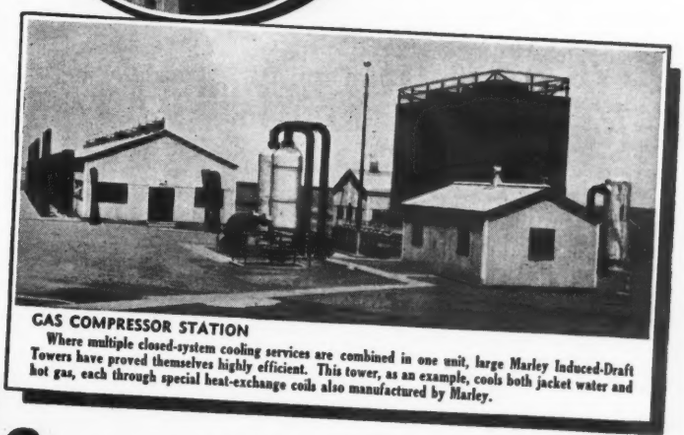
If you are considering new cooling equipment or are not satisfied with the performance or operating cost of an existing system . . . . .

***Consult a MARLEY Engineer!***

Your inquiry will receive the prompt attention of an engineer versed in the heat-exchange problems of your industry. His study and recommendations are without obligation.

OFFICE BUILDING

Where it is desirable to conform to a general architectural scheme Marley towers are readily adaptable. An example is this Marley Forced-Draft Tower, camouflaged in masonry, serving a large air conditioning system.



GAS COMPRESSOR STATION

Where multiple closed-system cooling services are combined in one unit, large Marley Induced-Draft Towers have proved themselves highly efficient. This tower, as an example, cools both jacket water and hot gas, each through special heat-exchange coils also manufactured by Marley.

# The MARLEY Company

**Fairfax and Marley Roads, Kansas City, Kansas**

NEW YORK • CINCINNATI • ATLANTA • TULSA • LOS ANGELES

and Exclusive Representatives in Other Principal U. S. Cities, Canada and Cuba

**• Mechanical Draft Cooling Towers • • Deck-Type Spray Cooling Towers • • Spray Ponds • Spray-Coil Towers • Atmospheric Spray Cooling Towers • Atmospheric Heat Exchangers and the Famous MARLEY Non-Clog Nozzles for Water Cooling, Air Washing, Brine Spraying, Ice Melting and Humidifying**

In Washington—
TRADE FRICK MARK
Refrigeration
Air conditions the Office Building of the Home Owner's Loan Corp., the Administration Building of the Dept. of Agriculture, the new Police Court, and the Medical Arts Offices—in addition to numerous theatres, stores, and restaurants.
Frick Equipment also provides cold drinking water throughout the Dept. of Commerce Building, the National Museum, Library of Congress, Govt. Printing Office, and Bureau of Engraving; it does test and research work for the Bureau of Standards and the Navy Dept.; it makes ice in several large commercial plants, cools milk at the Chestnut Farms and eight other dairies, freezes ice cream in four plants, keeps foods fresh at ten colleges and schools, and in many hotels, markets, etc.
Whatever your needs, look to Frick Engineers for complete and competent cooling service.
H. O. L. C. Bldg.—Air Conditioned with four Frick Machines, two of which appear above.
DEPENDABLE REFRIGERATION SINCE 1882
FRICK CO.
WAYNESBORO, PENNA. U.S.A.

MULTI-VALVE
STOP and THROTTLE
MULTI-STAGE

*The Universal Service Valve*

No. 501

Send for Bulletin 103

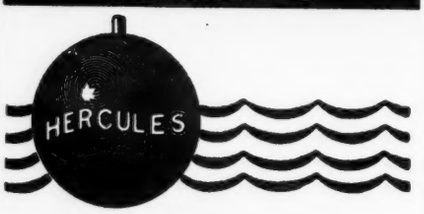
New York
11 W. 42nd St.
Boston
73 Tremont St.

Chicago
7 So. Dearborn
Kansas City
R. A. Long Bldg.

Philadelphia
Harrison Bldg.
Pittsburgh
Oliver Bldg.

*The* LUDLOW
VALVE MFG. COMPANY
TROY · · · · NEW YORK

HERCULES
*Seamless Copper*
FLOATS




GUARANTEED
TO STAND UP!

Every Hercules Float carries our guarantee to stand up under 350 lbs. working pressure and 500 degrees temperature.

Fabricated of seamless copper under our special spinning process, Hercules Floats are uniform in thickness and high in mechanical strength.

You can depend on Hercules for floats—in standard shapes up to 10 in. and in special types to your specifications—to give long, dependable, economical service.

Insure care-free maintenance of water level in your heaters, tanks, reservoirs and other equipment by specifying "HERCULES."

HERCULES FLOAT WORKS
200 Franklin St.
SPRINGFIELD, MASS.


ford, plans central-heating plants in three new senior and junior high schools, for which fund of $3,000,000 is being arranged through bond issue and Federal aid. Peterson & Johnson, Swedish-American Bank Bldg, architects, Rockford.

Pure Oil Co, 35 E Wacker Drive, Chicago, plans pumping plant, steel storage tanks and other equipment in new bulk terminal plant on Mississippi River, La Crosse, Wis. Cost over $100,000.

Batavia plans extensions in municipal electric plant and waterworks. Estimates of cost will be made by Wells Engrg Co, Geneva, consulting engineer. Financing through Federal aid.

**INDIANA**——V A Place, Crown Point, plans 2-story cold-storage and refrigerating plant, with locker system of 300 individual units. Cost over $45,000, with equipment. A E Childs will be in charge of construction.

Indianapolis Water Co, Indianapolis, plans improvements in Fall Creek water station, including new pumping machinery, water-treatment equipment and accessories. Cost about $515,000. Also plans elevated steel tank and tower, and auxiliary operating equipment in Blue Ridge district. Cost about $250,000. W C Mabee, chief engineer.

Washington will begin work soon on extensions in municipal power plant. Cost over $75,000. Bevington-Williams, Inc, Indiana Pythian Bldg, Indianapolis, consulting engineer.

Board of School Trustees, Huntington, plans central-heating plant for high and grade schools, gymnasium and library buildings. Bids will be asked soon. Cost about $48,000, with boiler units and auxiliary equipment. Financing through Federal aid. Robert W Stevens, 1033 Cherry St, Huntington, architect.

**IOWA**——Dayton plans municipal electric plant. Bond issue of $55,000 has been approved. Bids will be asked soon. R W Gearhart, Cedar Rapids, consulting engineer.

Remsen plans municipal electric plant, using diesel-generator unit. Cost about $56,000. Financing through Federal aid. Buell & Winter Engrg Co, Insurance Exchange Bldg, Sioux City, consulting engineer.

Sibley plans improvements in municipal electric plant. $151,400 through Federal grant and loan for project. Burlingame, Hitchcock & Estabrook, Minneapolis, Minn, consulting engineers.

Estherville plans water-softening and filtration plant for municipal waterworks. Cost about $51,000. Financing in part through Federal aid. Bids will be asked soon. Green Engrg Co, 417 First Ave, S E, Cedar Rapids, consulting engineer.

Board of Trustees, Iowa State College, Ames, plans addition to steam power plant for central heating at institution. Cost about $200,000. Financing through Federal aid. H C Gregg, business manager.

**KANSAS**——Winfield plans extensions in municipal electric plant. Cost about $177,000. Financing through Federal aid. Burns & McDonnell Engrg Co, 107 W Linwood Blvd, Kansas City, Mo, consulting engineers.

Oxford plans municipal gas-distributing system, including pipelines, control station, etc. Bond issue of $32,000 authorized. O B Wenrich, mayor, in charge.

Ottawa plans extensions in municipal electric plant, including 4000-kw turbine-generator, two boilers and auxiliary equipment. Cost about $150,000. Financing through Federal aid. Black & Veatch, 4706 Broadway, Kansas City, Mo., consulting engineers.

Neodesha plans addition to municipal electric plant, including turbine-generator and auxiliary equipment. Cost about $150,000. Financing through Federal aid. Black & Veatch, 4706 Broadway, Kansas City, Mo., consulting engineers.

Wellington plans improvements in municipal electric plant, including two new boiler units, pumps, 2,000,000-gal. filter plant and other equipment. Cost about $200,000. Financing through Federal aid. Black & Veatch, 4706 Broadway, Kansas City, Mo., consulting engineers.

Water Bureau, Topeka, plans new pumping station for water system, with motor-driven pumping machinery and auxiliary equipment. Cost about $100,000. Finance-

# BARTLETT·SNOW *provides* AUTOMATIC LOW COST COAL HANDLING FROM COAL CAR TO STOKER

● From the time it leaves the coal car until it is deposited in the stoker hopper, a Bartlett-Snow system handles the coal in a continuous, automatic and efficient manner.

Track hoppers are of generous size with sloping sides to eliminate arching. Loading gates are of automatic, and patented design. They close by gravity when the bucket is filled. Scraping and banging are avoided. Hoist engines, skip buckets, runways, head frames and bunkers are of proven Bartlett-Snow construction. The weigh larries eliminate segregation . . . prolong stoker and furnace life.

Six standard boiler plant layouts bring the advantages of this proven system within the reach of every engineer and boiler plant official. They reflect in their arrangement 35 years of intimate customer experience . . . combine maximum dependability with low operating and low maintenance costs. Each is adapted for installation in existing or new buildings . . . can be altered to meet a variety of plant and yard conditions. The layouts require a minimum of new engineering . . . permit therefore the maximum amount of the appropriation to be expended for actual plant facilities. Full details will be found in Bulletin 73. Send for a copy.

**THE C. O. BARTLETT & SNOW CO.**
6205 Harvard Avenue Cleveland, Ohio

*In New York*—30 Church Street
*In Chicago*—First National Bank Building

●

**BULLETIN NO. 73**

Complete with 44 diagrams, 12 tables, 90 illustrations. Describes the Bartlett-Snow method of securing less costly—more efficient operation. Send for one.

# BARTLETT·SNOW
## *Coal and Ash Handling Equipment*

TRACK HOPPERS • LOADING GATES • SKIP HOISTS • HOIST ENGINES
BUNKERS • WEIGH LARRIES • ASH HOPPERS • FIELD STORAGE

SPACE COUNTS IN EVERY PLANT

This blower delivers 24,000 CFM at 4" static pressure in a mid-western central power (Electric and Gas) station

at High Efficiency

The motor is inside the blower casing. Think of the comparative size of any other type of blower for the same capacity. COMPACTNESS AND HIGH EFFICIENCY dictate the use of the

WING type COM Forced Draft BLOWER

L. J. Wing Mfg. Co.

West 14th Street and 7th Ave.

NEW YORK N. Y.

ing concluded in part through Federal aid. Bids scheduled to be called soon. W E Baldry, city engineer.

Waterville, plans extensions in municipal electric plant. Cost about $29,000. Financing being arranged through Federal aid. Paulette & Wilson, 1006 Kansas Ave, Topeka, consulting engineers.

**KENTUCKY**——Daviess County Fiscal Court and City Commission, Owensboro, plans air-conditioning system in 6-story addition to county hospital. Cost about $250,000. Bids will be asked soon. Financing through Federal aid. Otis & Lea, Starks Bldg, Louisville, architects.

Board of Trustees, Julius Marks Sanatorrium, Georgetown Pike, Lexington, plans boiler plant for central-heating service at institution. $190,000 being arranged through Federal aid for this and other improvements at institution. Frankel & Curtis, McClelland Bldg, Lexington, architects.

Corbin plans improvements in municipal electric plant and waterworks pumping station. Capacity will be increased. Cost about $350,000. Financing through Federal aid. Burns & McDonnell Engrg Co, 107 W Linwood Blvd, Kansas City, Mo., consulting engineers.

**LOUISIANA**——Vernon Parish Police Jury, Leesville, plans central-heating plant for new local courthouse and jail. Cost about $130,000. Financing in part through Federal aid. Herman J Duncan & Co, Alexandria, architects.

Bossier Parish School Board, Benton, plans central-heating plant in multi-story high school near Fort Smith Park, Bossier City. Cost about $300,000. Financing through Federal aid. Jones, Roessle, Olschner & Weiner, Ardis Bldg, Shreveport, architects.

**MARYLAND**——Cumberland plans water-treatment and purification plant, with pumping station and distribution facilities. Cost about $1,025,000, of which $461,250 has been secured through Federal aid.

State Board of Public Works, Union Trust Bldg, Baltimore, will award contracts soon for extensions in power house at Annapolis, in connection with new multi-story state office building to be erected on neighboring site. Cost over $600,000. Laurence H Fowler, 347 N Charles St, and Henry P Hopkins, 10 E Mulberry St, both Baltimore, architects.

**MASSACHUSETTS**——Procurement Division, Public Works Branch, Treasury Dept, plans boiler plant at new marine hospital at Commonwealth Ave and Warren St, Brighton, Boston. Bids will be asked soon. $2,100,000 authorized for project.

Lever Brothers Co, Cambridge, plans complete air-conditioning system in 7-story office building at local soap-manufacturing plant. Also central-heating system. Cost over $450,000. Stone & Webster Engrg Corp, 49 Federal St, Boston, engineers.

**MICHIGAN**——Farmers Cooperative Co, Hampton Township, near Essexville, plans boiler house in connection with new local fruit and vegetable canning plant. Work scheduled to begin at once.

Shrine of the Little Flower, Royal Oak, care of Ditchy-Farley-Perry, Inc, Lincoln Bldg, Detroit, architects, plans central-heating plant at new school group of two high schools and one grammar school. Cost about $500,000. Bids asked soon.

Ford Motor Co, Dearborn, has work under way on expansion in steam-electric generating plant at River Rouge works, to include installation of high-pressure boiler unit, 110,000-kw turbine-generator and auxiliary equipment. Cost over $3,000,000. Work is scheduled for completion early in fall.

**MINNESOTA**——Warroad Co-operative Creamery, Warroad, contracted Johnson-Gillanders Co, 424 N Third St, Grand Forks, N. D., for construction of 2-story cold storage and refrigerating plant, with locker facilities. Cost about $30,000. Max O Buetow, 1931 University Ave, St. Paul, architect.

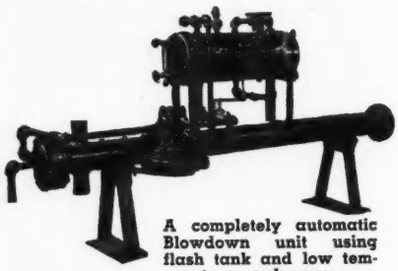
Board of Education, Red Wing, will take bids soon for central heating plant for central high school, industrial school and Washington school. Cost about $35,000. A D Martino, Metropolitan Life Bldg, Minneapolis, consulting engineer.

Willmar Cold Storage Co, Willmar, contracted Nelson Brothers Construction Co, Willmar, for cold-storage and refrigerating plant. Cost over $45,000 with equipment.

CHECK

Your Boiler Water Control Equipment Now!

Soon fall and the increase in the pulse of business will begin to put exacting demands on your Power Plant. Put your "house in order" now. Write for complete information and literature on the items below.



A completely automatic Blowdown unit using flash tank and low temperature exchanger.

Henszey Continuous Blowdown

Insures the proper concentration of boiler water at all times. Eliminates foaming, priming and scale. And this can be done—continuously and automatically—*without heat loss!*

Boiler Feed—Water Meter

This sturdy meter operates within 2% of absolute accuracy regardless of heat or dirt in the water. It also measures the flow of a reciprocating pump.

Flow Indicator

For steam, water, and other fluids. Positive. Self Contained. Goes right in the pipe line. Sanitary model meets all requirements for milk and other food fluids.

HENSZEY COMPANY

Dept. D8 Watertown, Wis.

HENSZEY

BOILER WATER CONCENTRATION CONTROL SYSTEMS